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ELECTRICAL WORLD

November 26, 1932

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You know the story. Searching far and wide for elusive wealth, happiness, peace or achievement, humanity has ever found it to have been within reach all the while — unrecognized. The Blue Bird was there all the time.

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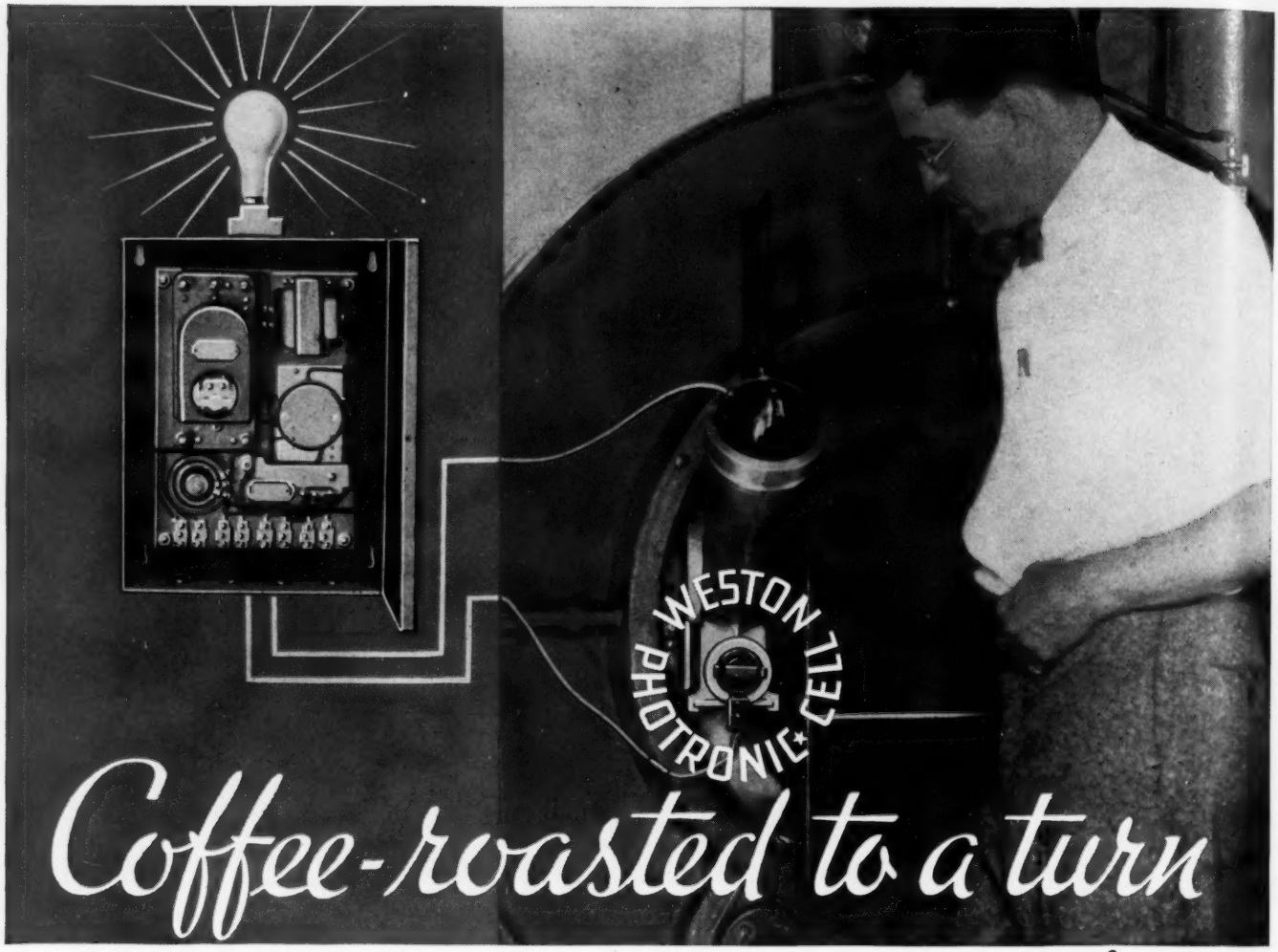
There's an undeveloped market for $5,621,000,000 a year more energy — for $21,820,000,000 of appliances — for $23,500,000,000 of equipment needed to supply that load.

$51,000,000,000 of Undeveloped Electrical Markets

[Detail data on the markets will be presented in the Annual Progress and Statistical issue of Electrical World . . . . January 7, 1933]

PUTTING LIGHT TO WORK



Coffee-roasted to a turn

PHOTRONIC★ PHOTO ELECTRIC CELL *"says when!"*

Now, PHOTRONIC★ photoelectric cells guard coffee flavor. By color, they "see" when the roast is done . . . and automatically flash a signal. No more guess work. No longer must the human eye with its wide margin of error be trusted with the delicate job of matching successive roasts. PHOTRONIC★ photoelectric cells guarantee the same color, the same flavor every time.

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Seven months of actual performance on the roaster clearly demonstrated the fitness of the PHOTRONIC★ photoelectric cell as a medium of precise control. It proved its unfailing reliability of operation and uniformity of response.

How can you apply the PHOTRONIC★ photoelectric cell to your business?

Weston engineers will gladly cooperate.

FACTS ABOUT THE PHOTRONIC★ photoelectric cell

SIMPLE—requires no amplifiers, no batteries or auxiliary power.

HIGH CURRENT OUTPUT—operates sensitive relays or instruments directly. 1.4 microamperes per foot-candle.

NO REPLACEMENTS OR MAINTENANCE—PHOTRONIC★ photoelectric cells have unlimited life. Characteristics are practically constant. Unaffected by fluctuating line voltages.

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NOT EASILY DAMAGED—dry type . . . no glass bulb, no liquid, no vacuum, no gas.

LOW COST

WESTON

★ PHOTRONIC—a copyrighted name used to designate the photoelectric cells and devices manufactured exclusively by the Weston Electrical Instrument Corporation.

ELECTRICAL INSTRUMENT CORPORATION

578 FRELINGHUYSEN AVENUE . . . . . NEWARK, N. J.

ELECTRICAL WORLD

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for the Week Ending

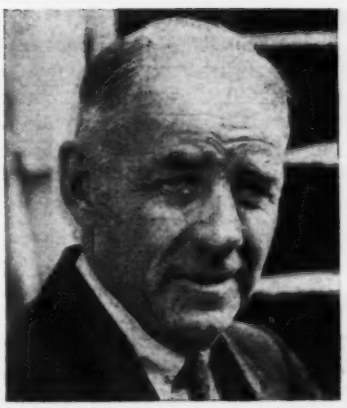
November 26, 1932

Lack of Funds Hinders Federal Trade Probe

For lack of funds the Federal Trade Commission will be unable to examine several important groups under terms of the Senate resolution calling for the investigation of utility holding companies now under way for several years. The commission, in its 47th interim report of progress, issued last week, makes known that it also will be unable to carry on as complete an examination as seems desirable of certain other groups which have been partially studied to date. None of these groups is identified in the report.

On resuming its investigation of companies in the Associated Gas & Electric System the commission was told at its first hearing last week that the fixed capital on the books of the New England Gas & Electric Association at the close of 1929 exceeded by $39,951,988 the fixed capital on the books of the various subsidiary companies of the association. In connection with the consolidated balance sheet of the New England group Examiner O. C. Van Zandt stated: "It has long been a moot question among prominent accountants as to the propriety of including on a balance sheet the fixed capital appreciation created through appraisals of physical assets, even though performed by reputable appraisers."

Continuing his testimony, Mr. Van Zandt told the commission that the principal sources of income of the association have been dividends on securities of subsidiaries, income of subsidiaries, income of subsidiaries not distributed, federal income tax accrued by subsidiaries, interest earned on open accounts and miscellaneous interest earned. He submitted computations showing that the association received dividend income in 1927 of $12,929, in 1928 of $837,415 and in 1929 of $669,045 from subsidiaries.



The deflation of commodities seems almost at an end. Hard work begins to fill up the gaps. The fingers of a new dawn stretch their tips above the horizon. There are signs of betterment decidedly more tangible than mere hope.

THOMAS W. LAMONT,
of J. P. Morgan & Company

[**Mr. Lamont, addressing the Conference of Universities last week, told delegates from 32 countries that war debts were "perfectly just but impossible," and criticised our contradictory trade policy of trying to sell goods abroad while buying as little as possible there.**]

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Commission Demands Cause California Merger Failure

Plans for the purchase of the Pacific Public Service Company by the Pacific Gas & Electric Company have been discarded because certain conditions regarding dividends and new issues demanded by the California Railroad Commission were opposed by the Pacific Gas Company. Negotiations between Pacific Gas and the Standard Oil Company of California have been pending for some time. (ELECTRICAL WORLD, July 16, 1932, page 69.) Following the announcement of the abandonment of the deal Pacific Public Service 5 per cent bonds, due in 1936, dropped 16⅜ points on the New York Stock Exchange and declines in the preferred stock occurred in San Francisco. Reopening of the deal is not regarded as likely in the near future.

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R.C.A. Separation Due Through Consent Decree

Settlement of the government's suit against participants in the "radio patent pool" was made this week through a consent decree under which it is agreed that, over certain specified periods, all Radio Corporation of America stocks owned by the General Electric and Westinghouse Electric & Manufacturing companies shall be disposed of; patent licensing relationships, between these and other companies, involving more than 4,000 patents, shall be altered, and numerous corporate changes shall be effected.

The companies, under the terms of the settlement, agreed to act without conceding the truth of the government's "anti-trust" allegations and upon the understanding that the decree would not be considered an adjudication that they had violated the Sherman anti-trust law.

Wall Street is said to view the move as the most decisive step in enforcing the Sherman act since the packers decree of 1920 and the breaking up of the old Standard Oil Company in 1911.

Radio Corporation stocks were heavily sold when the news came out, upon the presumable basis that if distributed to General Electric and Westinghouse shareholders they would soon reach the market in large volumes. Some observers sensed direct liquidation by the companies holding the securities. Half of the holdings of General Electric and Westinghouse must be disposed of within three months and the balance within three years. Distribution ratably to stockholders was ordered.

Power Board to Supervise Utility Securities

In making public a resolution unanimously adopted last week by the Federal Power Commission, George Otis Smith, chairman, stated that hereafter the commission will regulate the issuance of securities of public utility corporations licensed by it, in the absence of state agencies with that authority locally.

The new regulation provides that no licensee of the commission coming within certain provisions of the federal water-power act "shall issue any securities maturing more than one year from the date of issue, or any securities for construction purposes maturing less than one year from the date of issue without first submitting to the commission satisfactory evidence in support of such security issue in the form prescribed for that purpose, and securing the approval of the commission to said issue, such evidence to include the following when required by the commission: The value of the physical property covered by such security issue when non-project property is involved, outstanding obligations of the company proposing the issue, amount of the proposed issue, number, par value and issue price of the shares of stock or bonds or other securities proposed for issuance, and such other information as the commission may deem necessary or desirable . . ."

Commenting on the new regulation, which has been sent to all licensees, Dr. Smith quoted from the annual report now on the press in explaining that through its securities examiner the commission has made a study of the information required and the methods of regulating the security issues coming under federal jurisdiction. The report continued: "The need of thus providing for a beginning in administering the plain provisions of the act for taking jurisdiction over the issuance of securities by licensees, in the absence of state agencies with that authority, had been already presented to the house appropriations committee on February 5. It was then stated that making provisions for one specialist would at least enable the commission to plan for an adequate handling of this important phase of its work. That beginning has been made."

Jurisdiction over the security sales of one licensee organization, Portland General Electric Company, was assumed several weeks ago by the commission (ELECTRICAL WORLD, November 5, page 614).

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North American L. & P. Plans Stock Write-down

Reduction in the stated value of its common stock from $23.59 to $5 per share, reducing the book value of the 1,636,555 shares now outstanding from $42,773,975 to $8,182,775, is planned by the North American Light & Power Company. The proposal will be acted on at a special meeting of stockholders December 20. Included in the plan is the setting up of reserves to cover depreciations in values in the past few years. Control of the company is held jointly by several large utility organizations. Among them are the Middle West Utilities Company, the Commonwealth Edison Company and the North American Company, which is the largest holder with approximately 48 per cent of North American Light & Power common stock. The company is managed under a voting trust agreement, which has now three years to run. In commenting on the plan Frank L. Dame, president of the North American Company, said:

"The North American Company is entirely in accord with the readjustment plan of North American Light & Power Company, which is both conservative and constructive. We are taking a more active interest in the affairs of that company, our holdings having increased to approximately 48 per cent of the outstanding stock of North American Light & Power Company as the result of its last offering of common stock to stockholders on April 1, 1932. . . . Adjustments in the financial structure of North American Light & Power Company, of the nature of those proposed in the plan submitted to its stockholders, should strengthen the investment standing of its common stock. . . . We believe our investment in North American Light & Power Company is amply protected and is of great potential value."

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New Commerce Commission Asked in Illinois

Request for an Illinois Commerce Commission whose members will seek lower rates for electricity and gas was made in a telegram sent last week to Governor-elect Henry Horner by the Utility Consumers and Investors' League of Illinois. The message read in part: "The breakdown of utility regulation in Illi-

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HOOVER DAM NEARS FOUNDATION STAGE

Wide World

From 50-ft. tunnels, driven in canyon walls, the muddy Colorado emerges at the left to resume its journey to the sea after being diverted from its age-old way for the distance of a mile. The cofferdam in the foreground will withhold the flow from down stream while foundations are sunk ("Electrical World," November 19, page 681).

nois in the last decade under the régime of the commerce commission, resulting in losses of hundreds of millions to consumers and investors, the failure of gas, electricity, telephone and other utilities voluntarily to reduce the $425,000,000 annual bill paid by Illinois consumers during the depression demand the appointment of a new and independent commerce commission composed of highly trained and public spirited men." . . . The league requested a hearing of the Governor-elect. Recently it asked the state's attorney of Cook County to make an investigation of the commission (ELECTRICAL WORLD, November 19, 1932, page 680).

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Pennsylvania Investigators Hear of Associated Policy

At the close of another series of Senate committee hearings in the investigation of the Pennsylvania Public Service Commission, Oliver K. Eaton, chief counsel, was urged to prepare legislation which would curb the activities of holding companies and more effectively control mergers and the pyramiding of utility companies. The committee adjourned until November 30, after probing policies of two major systems, the Associated Gas & Electric and the Insull group. It also heard officials of the Pennsylvania Electric Association explain large expenditures of money made last year while the General Assembly was defeating Governor Pinchot's utility regulation program.

Charles Nodder, utility expert for the Federal Trade Commission, who made an exhaustive study of the Associated Gas & Electric System, related the results of his study to the committee, told how from 1922 to 1929 the average annual return on the capital of the system was 60.82 per cent, in 1929 was 164 per cent, and revealed that while 34 of the system's companies are in Pennsylvania but 26 of these are operating companies. The others are security sales firms or holding companies. Control of the entire system, he explained, is in the hands of H. C. Hopson and J. I. Mange. Control of the units of the system is centralized in the Associated Gas & Electric Corporation of Delaware, which, in turn, is owned by the Associated Gas & Electric Properties, a Massachusetts trust, which, Mr. Nodder stated, Hopson and Mange dominate. He said that Mr. Hopson receives no salary as head of the system nor as an official in underlying properties. Control of the system was gained in 1922 through the purchase of the control stock for $300,000. At that time the assets were valued at $6,000,000. They are valued now at $941,000,000, according to Mr. Nodder's testimony. Pennsylvania units of the system, he maintained, have been written up by $38,574,000 since being acquired by the system.

Oliver K. Eaton, chief counsel of the committee, now advocates an investigation of holding companies by the Public Service Commission to determine whether holding companies are functioning as operating companies in the state, whether present laws are being violated, whether book values have been inflated and securities issued irregularly and whether holding companies represented in the state will subject themselves to commission control. He said an inquiry of this sort probably would lead to a court decision on a question which never has been ruled upon by the Pennsylvania Appellate Courts.

Investment securities of six subsidiaries of the Associated Gas & Electric Company, operating in Pennsylvania, have been subpœnaed by the committee, following the filing in New York of a petition for receivership for Associated Gas & Electric.

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Presidential Warrant Out for Insull Extradition

Within a few hours after receipt in Washington of the warrant request of Governor Emmerson of Illinois for the extradition of Samuel Insull from his refuge in Greece President Hoover signed the Presidential warrant and it was despatched to the American Legation in Athens. Little action is likely until the document arrives there.

According to Greek rules of procedure the Court of Appeals will give the extradition request full consideration, but the sole conduct of the suit, if held, will be in the hands of Public Prosecutor Reganakos and no American attorney will be qualified to speak in court nor can the American Legation appoint a Greek lawyer to support the American claim.

Attempts to induce Mr. Insull to return without full legal process are said to have been abandoned. Mr. Insull's Greek attorney has announced that the action to secure the Chicagoan's release from detention before the 60-day period allowed will be made.

Senator Norbeck, chairman of the Senate banking and currency committee has announced that its investigation of the Insull failure will be resumed as soon as Congress reconvenes.

Testimony by E. E. Brown, vice-president of the First National Bank of Chicago, at a federal hearing last week indicated that the standstill agreement between Insull's creditor banks was effected to stave off difficulties until the Reconstruction Finance Corporation bill might be passed and contingent troubles avoided. Owen D. Young, it was revealed, acted as the intermediary in effecting the agreement.

International Debts Hold the Stage

Once more the question of debt settlements holds the attention of business. Thrown into sharp relief by President Hoover's invitation to Governor Roosevelt for co-operative handling, this restless ne'er-do-well problem is sure to be the subject of much heated and badly informed discussion. Essentially, less of the ability to pay than of the desirability of insisting upon payment seems to be involved.

General business pyschology is rising somewhat. Some classes of manufacturers, notably in the electrical group, report many inquiries and overtures, albeit without appreciable increases in orders. Commodity and security prices continue soft. General indexes are off appreciably. Car loadings dropped 51,290 in election day week, the fourth successive decline. Bituminous coal production is off for the third week. Energy production shows sustained strength.

If the reception accorded the Toledo Edison issue be an indicator, better investment markets are near. The automobile index stepped up ten full points as manufacturers started on pre-show production. Electrical manufacturing is holding with but little loss the gains made in September.

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Trolley-Buses Average 30,000 Kw.-Hr. Each Year

Utility companies which have seen their energy sales for electric street transportation services decline further and further with each succeeding year might well give a thought to the trolley-bus, which combines many of the advantages of both bus and trolley and still leaves the important matter of motive power as a source of utility revenue.

Recent studies by Westinghouse engineers indicate that the 256 trolley-buses now in service in the United States require about 30,000 kw.-hr. apiece each year and that a 40-passenger bus traveling 40,000 miles a year would represent a probable load of 120,000 kw.-hr. It is estimated that of the 60,000 passenger-carrying units which will serve the electric railway industry 10 to 20 per cent of these could be trolley-buses.

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Rockland L. & P. Receiver Denied

Application by a stockholder of the Rockland Light & Power Company, a New York utility, for a receiver (ELECTRICAL WORLD, September 24, page 392) has been denied by Supreme Court Justice Bleakley.

Coming Meetings

American Society of Mechanical Engineers—Annual meeting, New York, Dec. 5-9. C. W. Rice, 29 West 39th Street, New York.

American Association for the Advancement of Science—Annual convention, Atlantic City, N. J. Dec. 27-31. C. F. Roos, Smithsonian Institute, Washington, D. C.

American Physical Society — Annual meeting Atlantic City, Dec. 28-30. W. L. Severinghaus, Columbia University, New York.

American Institute of Electrical Engineers—Winter convention, New York, Jan. 23-27. H. H. Henline, 33 West 39th Street, New York.

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Bond & Share Yields Data; Court Order Postponed

Postponement by agreement last week of the entering of an order by the United States District Court for the Southern District of New York in accordance with the views expressed by Judge Knox in his opinions rendered last August (ELECTRICAL WORLD, August 27, 1932, page 261) is the most recent development in the law suit between the Electric Bond & Share Company and the Federal Trade Commission. Each party reserved the right to have the settlement of the order taken up at any time before the court.

In the meantime, pursuant to an agreement with the company, an accountant of the commission will begin an examination in the offices of the company of the company records and vouchers for the purpose of determining the cost to Electric Bond & Share Company of rendering certain services to its subsidiary, affiliated or associated companies in return for which a fee is paid, and for the purpose of learning other pertinent facts in connection therewith.

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Federal Power Commission to Investigate Ariel Project

Further regulatory aid has been asked for and received by Oregon's Utility Commissioner in connection with investigations of Portland companies (ELECTRICAL WORLD, November 5, 1932, page 614). Ralph E. Williamson, Federal Power Commissioner, will hold hearings in that state for the purpose of obtaining information regarding the actual construction costs of the Ariel development project of the Inland Power & Light Company, controlled by the Pacific Power & Light Company, which is controlled by the American Power & Light Company.

The hearing was ordered at the instigation of the Oregon Commissioner, who requested the co-operation of the government in the complete investigation of the properties operated by the Northwestern utility. This company receives much of its energy from the project located in the State of Washington, and to enable the Oregon department accurately to value Northwestern properties for rate-making purposes the interstate authority of the federal department was deemed necessary by the state commission.

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Commissioners Vote Reform Resolutions; "Original-Cost" Base Favored

MORE comprehensive statutes for the regulation of holding company relationships and a program of fact finding on a national scale are the means by which the state regulatory authorities hope to relieve operating utilities of the incubus of remote control. Out of the dicussion of the holding company in the first day's session (see ELECTRICAL WORLD, November 19, 1932, page 676) of the annual convention of the National Association of Railroad and Utilities Commissioners at Hot Springs, Ark., last week came two resolutions adopted in a subsequent session. One committed the association in favor of the enactment of comprehensive state legislation for the regulation and supervision of the transactions, contracts and other business arrangements and relationships between utilities and holding companies. A second directed the committee on legislation to support legislation which would make available to the state commissions, presumably through federal channels, the facts as to the corporate relationships between the holding companies and their operating subsidiaries in their bearing on the reasonableness of charges for services, commodities and construction. As the sessions progressed it became even more evident than on the first day that state regulation is rapidly finding itself competent to regulate the service aspects of the holding company even in the absence of state or federal laws specifically conferring such powers.

Valuation for the purpose of ascertainment of reproduction-cost-new would be largely out of favor if the courts permitted. Weight attached to it is sinking to new low levels. More emphasis is progressively being placed on original cost and periodic additions in view of the increasing fund of data on file with the commissions. Price trends in the industry are consequently accorded an increasing recognition as a means of establishing "present value," so much dwelt upon by the courts. These were the outstanding trends in the discussion on valuation.

Negotiated rates favored

Negotiation and conference procedure to expedite rate adjustments is also meeting with increased favor, especially where a *prima facie* case for reduction is fairly manifest on the record. With enlarged resort to this practice is coming a greater tendency to make rates for trial periods, particularly in instances where the prospective earnings may fall close to a confiscation level and thus necessitate aggressive promotional activity on the part of the utility. Likewise, where the proceedings are conducted on the formal plane and appeals to federal courts are frequent the association went on record as favoring legislation prohibiting federal courts from granting injunctions or adjudicating the cases until the remedies provided in the state courts have been exhausted.

Shall utilities pay regulation costs?

To make regulation as effective as the public expects would, according to Examiner G. C. Matthews of Wisconsin, cost five times what it does now. With legislatures everywhere trimming budgets the burden must be assessed directly on the companies—out of surplus if the rates are shown to be too lucrative and out of the rate payer if they are more nearly within the area of reasonableness. Only by larger staffs can commissions make regulation effective. The hymns of praise of state regulation sung by the utilities have been founded on the realization that has been only partly as effective as desired by the public, and perhaps could never be made effective. Assessment of the cost of regulation upon utilities was stated by General Solicitor Benton to be more prevalent a provision of state laws than is commonly sensed. A summary of the national situation in this respect will be incorporated in the proceedings of the convention. A committee was instructed to prepare a draft of a uniform law embracing the salient features of the existing statutes. This instruction was given without, however, committing the association to the principle of the assessment.

J. Paul Kuhn of the Illinois Commerce Commission was elected president after Hugh Williams had been elected to that office and resigned, effective December 31, 1932, on account of his defeat for re-election to the New Mexico Corporation Commission in the voting on November 8. Several similar casualties were reported and there were also presentiments that appointments by the many new governors might further remold the ranks of the association. The next annual meeting will be held in Cincinnati, Ohio, beginning on the first Tuesday of October, 1933.

Associated Gas & Electric Receiver Asked by Investor

Alleging mismanagement of the corporation's funds and seeking a receivership for Associated Gas & Electric Company pending the action for an accounting from the officers, Philip Newbold owner of 100 shares of preferred stock, has entered suit against the corporation. The suit states that the company has been mismanaged by H. C. Hopson, vice-president, treasurer and director, who, it is said, dominates the company and manages it through alleged dummy directors. Other officers of Associated are also named as defendants, as are affiliated organizations.

The mismanagement charged is alleged to have impaired the credit of the corporation so seriously that new financing is difficult at present. The necessity of taking up $18,000,000 in short-term notes is cited as an immediate problem. "Excessive and illegal fees" are specifically mentioned as factors in the mismanagement.

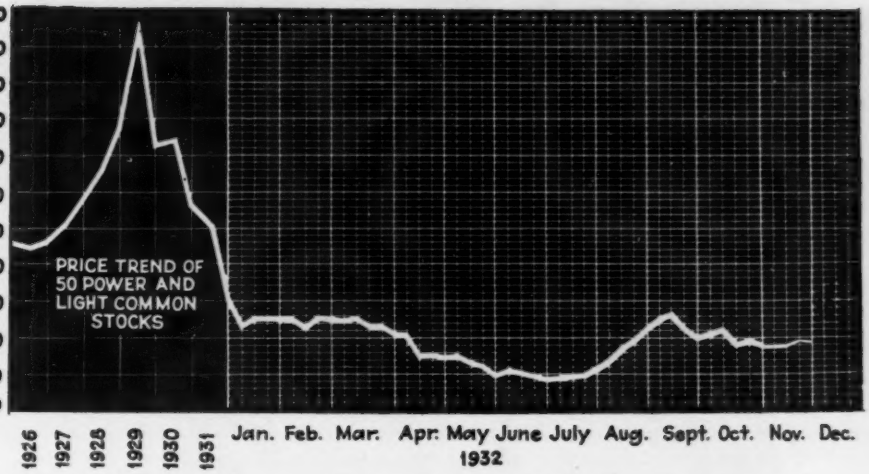
Associated issues statement

"The action and the application for a receiver are based upon a complaint, all material allegations of which are false," it was declared by Associated.

"The Associated Gas & Electric Company has no short-term debt nor are its subsidiaries faced with any immediately maturing short term debt which they are not in a position to take care of. The company states that while the earnings are, of course, affected by the business depression, in common with most other companies and industries, its financial condition is better than at any time since the depression began.

"The allegations in the complaint of large personal profits from management, construction, purchasing and appliance contracts with operating subsidiaries are made with gross disregard of the truth. The reports of the Federal Trade Commission's own examiners show that the companies engaged in rendering these services are 100 per cent owned subsidiaries of Associated Gas & Electric and that no individuals derive any personal profit from them."

Utility Stocks Recede



In a market which, generally speaking, was dull price changes in the electric light and power stocks carried the "Electrical World" index down 1.4 points, from 29.7 to 28.3.

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Current Earnings Reports of Electric Light and Power Companies

Operating Companies

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Brooklyn Edison					
(Year ended September 30)					
Gross earnings	$48,060,388	$47,733,122	+ 0.7	67	62
Net earnings	15,757,946	18,197,626	—13.4	..	..
Net balance +	13,039,457	15,422,395	—15.5	..	..
Detroit Edison					
(Year ended October 31)					
Gross earnings	44,633,180	50,010,146	—10.6	70	65
Net earnings	13,236,405	17,298,054	—23.5	..	..
Net balance +	7,187,029	11,341,649	—36.8	..	..
Louisville Gas & Electric					
(Year ended September 30)					
Gross earnings	10,041,079	10,871,578	— 0.8	56	53
Net earnings	4,423,270	5,110,225	—13.4	..	..
Net balance	1,782,594	2,380,525	—25.0	..	..
New York State Elec. & Gas Corp.					
(Year ended September 30)					
Gross earnings	13,156,452	13,194,439	.....	67	65
Net earnings	4,333,996	4,571,349	— 5.2	..	..
Net balance +	2,583,953	2,830,515	— 8.6	..	..
Northern States Power (Del.)†					
(Year ended September 30)					
Gross earnings	32,944,388	33,956,954	— 3.0	59	57
Net earnings	13,576,323	14,543,893	— 6.7	..	..
Net balance*	2,702,150	3,908,008	—30.8	..	..
Pacific Gas & Elec. and subsidiaries					
(Nine mos. ended September 30)					
Gross earnings	64,553,581	66,464,242	— 2.7	56	55
Net earnings	28,215,589	30,022,630	— 6.0	..	..
Net balance	10,117,464	12,685,200	—20.3	..	..
Rochester Gas & Electric					
(Year ended September 30)					
Gross earnings	13,912,316	14,645,870	— 5.0	64	66
Net earnings	4,998,660	4,903,530	+ 1.9	..	..
Net balance	2,085,785	1,949,439	+ 7.0	..	..
Union Electric Light & Power Co. of St. Louis					
(Year ended September 30)					
Gross earnings	28,494,004	31,651,817	—10.0	54	56
Net earnings	13,190,997	13,944,146	— 5.4	..	..
Net balance	6,382,044	8,931,380	—28.6	..	..

†Operating expenses for 1931 include $105,000 credit for withdrawal from contingent reserve.

Holding Companies

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Columbia Gas & Electric and subsidiaries					
(Year ended September 30)					
Gross earnings	$81,140,142	$92,830,884	—12.6	67	67
Income from subsidiaries	21,790,168	26,603,098	—18.1	..	..
Net balance	12,031,593	17,711,306	—32.0	..	..
Consolidated Gas Co. of New York and affiliated companies					
(Year ended September 30)					
Gross earnings	235,353,649	244,273,753	— 3.7	66	65
Net balance	50,070,081	58,443,329	—14.3	..	..
North American Co. and subsidiaries					
(Year ended September 30)					
Gross earnings	116,736,787	128,291,247	— 9.0	61	61
Net balance	17,172,218	23,390,187	—26.6	..	..
Public Service Corp. of New Jersey and subsidiaries					
(Year ended October 31)					
Gross earnings	128,857,081	138,364,373	— 7.0	66	67
Net balance +	29,563,860	31,545,042	— 6.2	..	..
United Gas Improvement and subsidiaries§					
(Year ended September 30)					
Gross earnings	103,672,827	108,752,533	— 4.7	56	57
Income from subsidiaries	25,772,269	27,550,927	— 6.4	..	..
Net balance	32,099,546	34,829,603	— 7.8	..	..
United Light & Power and subsidiaries					
(Year ended September 30)					
Gross earnings	81,112,559	89,398,900	— 9.3	68	68
Income from subsidiaries	8,745,245	11,572,862	—24.5	..	..
Net balance	1,992,458	4,704,757	—57.7	..	..

*Less than common dividend requirements.
§Excluding the Philadelphia Gas Works Co.
+Balance available for preferred and common dividends.

Gross earnings — (Operating Companies) Gross operating revenue. (Holding Companies) Gross operating revenue plus other income. Net earnings — Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Income from subsidiaries — Balance available from income of subsidiaries for holding company. Net balance — Balance available from income for common stock dividends.

Weekly Output Curve Turns Up

After a moderate sag in the two preceding weeks the energy output of central electric light and power stations returned nearly to its previous maximum of the season, rising to 1,531,584,000 kw.-hr. for the week ended November 19. This leaves the deficiency at 7.5 per cent, compared with 1,655,051,000 kw.-hr. in the corresponding week of 1931, according to statistics announced by the National Electric Light Association.

In the Central industrial region conditions compared with 1931 remained stable, with an output much closer to last year's than it was during the summer. In the East the disparity widened, whereas on the Pacific coast it decreased materially. The former change is ascribed chiefly to weather conditions and the latter to an increased load for irrigation.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1932	1931	1930	1929
November 19	1,532	1,655	1,722	1,818
November 12	1,521	1,623	1,713	1,794
November 5	1,525	1,628	1,728	1,798
October 29	1,533	1,652	1,741	1,816
October 22	1,528	1,647	1,747	1,824

Per Cent Change from 1931

Region	Week Ended Nov. 19	Nov. 12	Nov. 5
Atlantic Seaboard	—7.0	— 3.2	—2.6
New England alone	—7.4	— 1.0	—3.5
Central industrial	—9.2	— 8.9	—7.8
Pacific Coast	—7.6	—10.9	—9.1
United States	—7.5	— 6.3	—6.3

▼

Alabama Commission Granted Wider Regulatory Power

Legislation restricting the freedom in the relationship between the Alabama utilities and their holding companies or affiliated interests, sought by the Alabama Public Service Commission (ELECTRICAL WORLD, September 3, 1932, page 292), was passed at the recent legislative session. Under provision of the Harrison act, dealing with state laws relating to the regulation of utilities, every utility in Alabama must file with the commission early next month a sworn statement of every existing agreement between it and any holding corporation. The act gives the commission authority to suspend payment of dividends, prohibit issuance of notes, cancel agreements with holding companies and otherwise exercise rigid control over utility affairs.

Data contained in the statements to be submitted to the commission will be used as the starting point for the coming investigation of the utility companies of the state by the state commission. Governor Miller gave as one reason for calling the Legislature into session last August the need "to declare the rights, powers and limitations of the holders of various classes of stock of domestic corporations engaged in the business of distributing gas, water and electricity to the public" (ELECTRICAL WORLD, August 13, 1932, page 196).

▼

Columbia Engineering Fees Now on "at Cost" Basis

Although made effective as of July this year, it has only recently become generally known that Columbia Engineering & Management Corporation, agency of the Columbia Gas & Electric Corporation, has introduced a new schedule of fees for services to subsidiaries of the Columbia system based upon the contention that services are to be rendered on a co-operative basis from which the profit element is eliminated.

Previously the arrangement between Columbia and its underlying companies was that 2½ per cent of gross earnings of properties should be paid to Columbia for operating services, while engineering services were rendered upon a basis of costs and incidental expenses.

The new plan calls for compensation for operating services at the rate of 1.2 per cent (with certain exceptions) plus one-twelfth of seventeen-hundredths of 1 per cent of the fixed capital account as of the close of the preceding quarterly period. Any excess of return to Columbia from such fees above the cost of operation will be refunded clients upon the basis of fees paid.

Commonwealth & Southern and Stone & Webster are two other large organizations following a similar policy, after having previously charged otherwise.

▼

America's Lighting Sales Are 85 per Cent Electrical

Based upon figures compiled by the U. S. Bureau of the Census, lighting in America, in so far as each year's production of lighting equipment by lighting equipment industries is concerned, appears to be about 85 per cent electrical. The total value of equipment produced in 1931 was $64,722,061, as compared with $137,593,290 in 1929. Electric lighting equipment accounted for $54,984,348 in 1931.

Residence lighting accounted for $25,560,136 in 1931, $51,256,780 in 1929; commercial equipment for $7,890,647 and $15,300,476, industrial lighting for $1,153,320 with the 1929 figure incomplete. Miscellaneous electric lighting equipment totaled $18,600,859 in 1931, of which $13,155,761 was for motor vehicle use. That classification of business which continued best to hold the sustained interest of manufacturers and, supposedly, buyers was the factory equipment, which fell from $1,630,983 to $1,153,320, or but 30 per cent, while the average loss was about 50 per cent and the worst sufferers were window and show case lighting and wall bracket or candelabra lights, which were off between 70 and 80 per cent on the average.

In 1931 the lighting equipment industries employed 14,346 wage earners, a decrease of 39.2 per cent from 1929, involved 503 plants, a decrease of 18.1 per cent, and paid 17,494,238 in wages, a decrease of 47.4 per cent.

These figures and the classification of lighting equipment manufacturers used do not include the production of incandescent electric lamps.

New York Metal Prices

	Nov. 15, 1932 Cents per Pound	Nov. 22, 1932 Cents per Pound
Copper, electrolytic	5.375	5.375
Lead, Am. S. & R. price	3.15	3.00
Antimony	5.875	5.75
Nickel ingot	35.00	35.00
Zinc, spot	3.50	3.50
Tin, Straits	24.15	23.30
Aluminum, 99 per cent	23.30	23.30

▼

Illinois First State to Obtain Federal License

Action of the Federal Power Commission in granting authorization last week to the state of Illinois for a major power project has aroused special interest, inasmuch as this is the first license issued by the commission to a state in the twelve years that the federal water-power act has been in force. The project covered by this license includes a power plant at the Brandon Road Dam on Des Plaines River near Joliet, construction of which shall begin on or before January 1, 1934, and completed in two years, and also two other plants to be constructed at such times as the commission may direct. These other sites are the Dresden Island Dam and the Starved Rock Dam, both on the Illinois River. The total installed capacity of the three proposed plants will be in excess of 90,000 hp., the Brandon Road Dam plant being 32,000 hp. The period of the license will be 50 years and the terms specified express all the preferences allowed in the act to state or municipal licensees.

Negotiations long under way

Federal Power Commission action on the state's program marks the culmination of years of negotiations in which progress has been impeded by the dispute with the Great Lakes states over the amount of diversion to be permitted from Lake Michigan at Chicago. Action on the state's application for development of four power projects on the waterway filed in 1925 was forced to be held up because of the lake level litigation.

Following the decision of the United States Supreme Court in the sanitary district case last February, the state of Illinois filed an amended application with the Federal Power Commission seeking postponement of action on the proposed power development unit at Marseilles.

Arguments before the Supreme Court in the case involving the appeal of Great Lakes states for federal authority to expedite the construction program of the Chicago sanitary district have been postponed until December 5.

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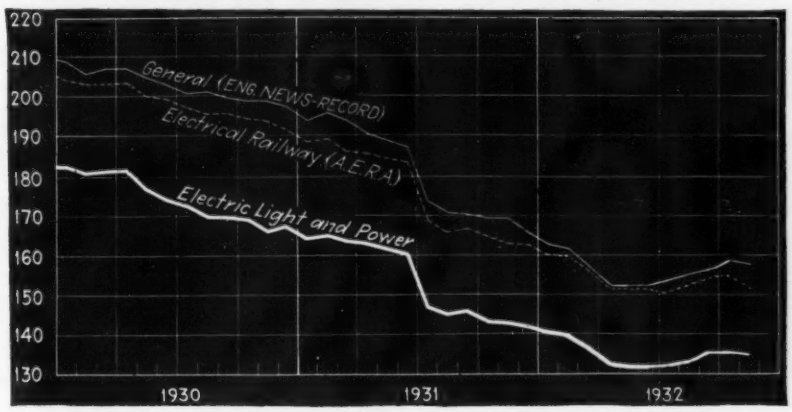
Construction Cost Rise Stops



Construction costs for electric light and power, after rising gradually from the low point of last June, have now turned slightly downward. The index fell from 136 on the 1913 base in October to 135 in November. Owing to an equal decline last year present costs are again down 6 per cent from 1931, as they were last month, but are now approximately 3 per cent above last summer's minimum.

Similar changes from October occurred in the two other construction indexes shown for comparison. In general construction the decrease was about equal to that in electric light and power construction; in the electric railway field it seems to have been a trifle larger, but not significantly so.

Construction Cost Indexes: Electric Light and Power, Electric Railway and General

Base: 1913 = 100

	Electric Light and Power*	Electric Railway*	General—*Engineering News-Record*
November, 1932	135	152	158.2
October, 1932	136	154	159.2
September, 1932	136	155	158.0
August, 1932	133	153	156.8
July, 1932	132	150	153.4
November, 1931	143	164	169.3
Last 5 yrs. high. Month	184 Apr. '29	206 Nov. '28	210.4 Feb. '29
Last 5 yrs. low. Month	131 June '32	150 June '32	152.2 June '32

*Computed by Albert S. Richey

Major New Construction This Week

Electric pumps, transformer equipment, panelboards, etc., needed for 80-mile pipe line of Pure Oil Company and Sun Oil Company from Toledo to Detroit. A $500,000 project.

Refrigerating machinery, motors, switchboard equipment, conveyors, etc. will be installed by Consolidated Ice & Cold Storage Company, Anaheim, Calif. Cost about $100,000.

Bids soon asked by Board of Works, Fort Wayne, Ind., for construction of overhead and underground transmission line from hydro-electric power dam to city power plant. Cost over $650,000. Equipment needed for addition to city power station. Cost over $100,000.

Heavy-duty motors, machine drives, transformer equipment, pumps, conveyors, etc., needed for four incinerators to be constructed by Detroit, Mich., bids closing January 18. Total cost about $2,000,000.

Until November 30 Board of Awards, Baltimore, Md., asks bids for switchboard and complete appurtenances for electric-operated pumping plant at Montebello for water department.

Electrical Workers' Union Settles Suit by Members

An agreement between certain members of the Electrical workers' Union, Local 3, New York, and certain other members and officers of the organization was reached last week, bringing to a close a bitter row, which has disturbed the group for more than a year. The agreement was filed with the state Supreme Court, where an order was issued making effective the stipulation of settlement and discontinuance of the suit. The suit, filed in 1931, sought an accounting of $7,500,000 alleged to have been spent by officers of the union.

Early this year the plaintiffs held a meeting in support of the suit, whereupon they were brought up on charges, suspended from the union for a year and fined $300 each. Later they obtained injunctions staying the defendants from imposition of these penalties pending trial of the accounting suit. After providing for the vacating of the injunctions obtained by the plaintiffs, the agreement assures the restoration of free speech in the union and a guarantee of recognition for every member in good standing. Among other points won by the workers was that any member of the local may obtain employment from any electrical contractor without first obtaining permission from the union. Under the agreement the defendants obligate themselves to reopen and reconsider the cases of all the plaintiffs with reference to fines and penalties imposed upon them.

Electrical Manufacturing Payrolls

Figures compiled by the U. S. Department of Labor and issued last week show that in the electrical machinery, apparatus and supplies industry employment fell off from September to October 2.5 per cent, the index figure standing at 49.3, as compared with 50.6 in September. The decline from October, 1931, was 34.7 per cent, the index figure for that month having been 75.6. Payroll totals, however, changed but slightly during the month, the index figure for October being 32.8, against 32.9 for the preceding month, but amounting to approximately half of the total recorded for October, 1931, when the index figure was 62.7.

▼

Shaft Sunk by Freezing Process

In sinking shafts for the condensing water intake and discharge at the new Tir John generating station of the Swansea Corporation (England) a "freezing tube" process was successfully used. To arrest the percolation from water-logged ground the soil at depths as great as 172 ft. below ground level was frozen by the tubes while permanent linings were placed, thereby avoiding collapse of the shaft walls during sinking.

▼

Seattle to Plead With R.F.C.

Undaunted by previous turndowns and unsatisfied with the semi-official offer of $1,650,000 which the Reconstruction Finance Corporation appears willing to loan the city of Seattle for expansions to its municipal power and light project, a delegation of four, including Supt. J. D. Ross, will journey to Washington once more seeking a minimum of $3,000,000 for City Light.

▼

Holding Company in Receivership

An equity receiver has been appointed for the Western Power, Light & Telephone Company, which operates nineteen public utilities in 275 communities in the Middle West. The petition for a receiver was filed on behalf of a group of holders of notes to the amount of $150,000. The bill recites that there was a default on bonds on August 1 of $465,802. Officials consented to the receivership to prevent lawsuits, which might jeopardize the assets of the company.

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British Electricity Consumption Up

During the month of October 1,098,000,000 kw.-hr. of electricity was generated in the United Kingdom, as compared with the revised figure of 1,037,000,000 kw.-hr. in the corresponding month of 1931, according to reports issued by the British Electricity Commission. This constitutes an increase of almost 5.9 per cent. During the first ten months of 1932 the total output was 9,730,000,000 kw.-hr., as compared with the revised figure of 9,095,000,000 kw.-hr. for the similar period of 1931, an increase of approximately 7 per cent.

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Holding companies, if unrestrained and unregulated, will repeat past performances and lure the public into purchase of their highly speculative securities in such a way as again to perpetrate injuries upon the public investors and again bring damage and injury upon their operating utilities and all who are interested therein.

HUGH WHITE,
President
Alabama Public Service Commission

[Commissioner White, sadly skeptical, views the problem of holding-utility company relationships as one virtually beyond successful state regulation.]

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Western Power Resources Surveyed

Engineers of the U. S. Geological Survey reporting upon potential water powers of a number of Western streams show two of sufficient size to be of importance. Row River, a tributary of the Willamette, could develop 10,000 hp. 90 per cent of the time and 20,000 hp. for 50 per cent of the time with storage. The Molalla River would yield 13,000 hp. and 39,000 hp. under the respective conditions.

▼

Lighting Control Brings Savings

At the Chisholm Ryder plant, Niagara Falls, N. Y., Westinghouse photo-electric control of lighting saves 4,000 kw.-hr. monthly, reduces lamp replacements one-fourth, improves production and reduces accidents. By having a photo tube directly gage the intensity of daylight the lights in the plant are automatically turned on during cloudy weather and later extinguished when daylight returns to normal intensity. The photo-electric lighting control relay consists essentially of a photoelectric tube, amplifier and a sensitive relay.

▼

Rate Survey Ordered in Virginia

According to an announcement made at the headquarters of the League of Virginia Municipalities, Richmond, the American Public Utilities Bureau of New York has been retained by certain cities and towns of Virginia to make a survey of public utility rates. The survey, ordered as a result of contributions received from 30 cities and towns of the state, will be completed prior to December 1. Dr. Bauer, director of the American Public Utilities Bureau, has been examining records at the offices of the State Corporation Commission.

Colorado Plant Nearing Completion

A 3,000-kw. hydro-electric station, known as the Grand Valley power plant, is rapidly nearing completion on the Colorado River and will probably be in operation before January 1, 1933. This project, designed by U. S. Reclamation engineers at Denver, was financed by Public Service Company of Colorado and will ultimately become the property of the Grand Valley Water Users' Association, a reclamation district.

▼

Removal of Commissioners a Problem

Having pledged in campaign addresses that he would remove all the members of the present Indiana Public Service Commission if gaining office, Governor-elect McNutt faces a problem. State laws only provide for removal "for cause," inevitably a long-drawn-out process, and two commissioners are serving terms which expire in 1935 and 1936. New legislation is suggested.

▼

Cobble Mountain Plant on the Line

Cobble Mountain hydro-electric station of the Springfield (Mass.) municipal water supply system on Little River went into service on November 12, recent rains having filled the new reservoir to an elevation of 920 ft. above sea level. The 30-year contract, under which the city leases the plant to the Turners Falls Power & Electric Company, is now effective. The contract provides that the power company may use the storage in the reservoir above that required for the city, as fixed by a given set of reservoir elevations during different months of the year. As the city's consumption of water increases with population growth, the depth to which the storage may be drawn and the amount of storage allowed the company is decreased, with corresponding reduction in yearly rental (ELECTRICAL WORLD, September 26, 1931, page 536).

▼

Another North Carolina Rate Cut

Pursuing its policy of ordering rate reductions upon investigation (ELECTRICAL WORLD, November 19, page 680) the North Carolina Corporation Commission has directed Duke Power Company and its subsidiary, Southern Public Utilities Company, to introduce a schedule which may mean a saving of $1,357,000 annually to customers.

▼

Treated Poles Serve Many Years

Of 2,000 pressure creosoted poles placed on the lines of the Key West Electric Company in 1905 not one had failed at the time of the 1930 inspection. They had been in the path of four hurricanes,

two of which were extremely severe, and during which near-by buildings were razed.

▼

Mercury Cycle Saving Estimated at 31 per Cent

Investment costs per kilowatt-hour for mercury-steam cycle generating equipment, now under construction and installation, are estimated by A. R. Smith, managing engineer turbine department, General Electric Company, to be lower by 31 per cent than the comparable costs for the nearest competing form of generating facilities. Mr. Smith, in speaking at the annual meeting of the New York Railroad Club last week, outlined some of the elements in the engineering decision to proceed with other mercury-vapor plants following the experience gained with General Electric equipment at the plant of the Hartford Electric Light Company.

Approximately 300,000 lb. of process steam capacity was needed by General Electric at Schenectady and preliminary estimates indicated that facilities to supply this at 200 lb. per square inch gage would have cost about $1,600,000 without any power generation whatever. A 400-lb., 750-deg. steam plant generating 7,400 kw. and 300,000 lb. of process steam would have cost $2,500,000. A 1,200-lb. plant generating 14,000 kw. would have cost $3,000,000. The 26,000-kw. mercury-steam plant was estimated at $3,400,000. The net investment per kilowatt was figured as: 400-lb. steam, $128; 1,200-lb. steam, $100, and mercury-steam, $69.

That the cycle adopted for Schenectady comes close indeed to 100 per cent theoretical efficiency was one of Mr. Smith's contentions. The use of the process steam raises the cycle efficiency there to nearly 100 per cent, as compared with the 59 per cent available in the Kearny installation of Public Service Electric & Gas Company. That the relatively low pressure cycles in general use have a cycle efficiency of about 32 per cent and that 1,200-lb. plants have a corresponding figure of about 47 per cent was also pointed out.

At Schenectady the mercury is to be raised to 125 lb. gage, 950 deg. F., bringing the steam to 400 lb. gage as it leaves the mercury unit and being taken from the steam turbine at 200 lb. gage for process use.

So definitely do the construction elements and contractual phrases co-ordinate that the Schenectady project must be viewed not as a by-product steam undertaking but as a by-product electricity project. Steam generating for General Electric is the major object and the production of electrical energy by the lessee, New York Power & Light Corporation, is but the incidental purpose.

▼

English Street Lighted With Gaseous Sources

An experimental installation of General Electric gaseous discharge lamp equipment along a street near that company's laboratories at Wembley, England, was described by C. C. Paterson, director of the laboratory and past-president of the Institution of Electrical Engineers, at a recent meeting of the British Illuminating Engineering Society.

With 400-watt units an efficiency of 40 lumens per watt is reported to be consistently attained with this hot-cathode type of source. Mr. Paterson assured his audience that in a practical sodium vapor lamp an output of 70 lumens per watt has been reached. The new tubes used at Wembley may, it is said, be fitted in ordinary sockets for ordinary voltages. Light is monochromatic.

▼

Revenue Rises 1 per Cent If Voltage Is Maintained

Based upon a painstaking and expensive investigation recently reported upon by Merrill De Merit, assistant chief engineer West Penn Electric Company, the conclusion has been drawn that "the percentage of possible increase in revenue by reason of bringing all voltages up to normal at all times would usually be of the order of half the percentage increase of consumption, or a little more than 1 per cent. This may be considerable and may frequently justify minor changes in distribution, but it seldom justifies any appreciable change unless some other contributing factor exists."

Mr. De Merit also reported that under certain assumed conditions, as near the practical average as can be determined, and with all lighting load at all customers the actual loss in kilowatt-hour consumption from the extreme customer at the time of a maximum low voltage deviation of 10 per cent is at the rate of 17.5 per cent of the consumption of the customer at that time. The average rate of loss from all customers is, under the same conditions, 9.5 per cent of their rate of consumption. The percentage loss of the annual consumption of all customers would be 2.7 per cent rather than the 21 per cent which would be determined by taking the ratio of the square of the two voltages to the extreme customer under two conditions.

Caution against using these conclusions without study of the individual system involved and of the assumptions made was offered by Mr. De Merit.

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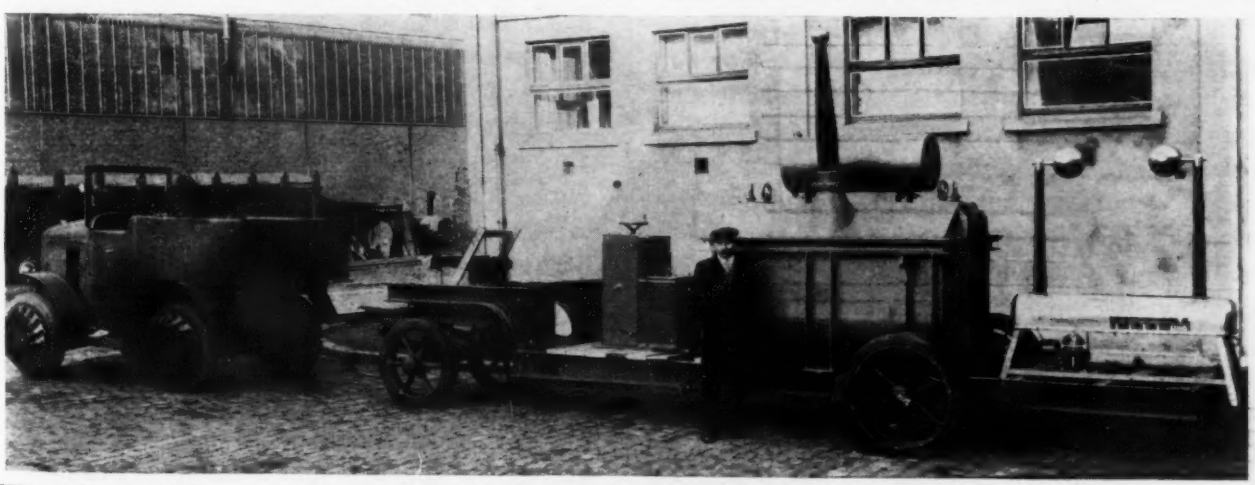
300-KV. PORTABLE TEST SET AIDS BELGIAN UTILITY



When the Société des Ateliers de Constructions Electriques of Charleroi, Belgium, wants to make some transmission line tests from isolated points this motor-trailer unit rumbles over the Belgian blocks and out into the country. The test set has a capacity of 100 kva. at 300 kv.

EDITORIALS

L.W.W.MORROW
Editor

Rehabilitation and power sales objectives

IN THE present state of business operating costs are of abnormal importance to every manufacturer. The volume of production is so low that gross profits are too often inadequate to cover overhead and every possible device is being resorted to that offers to reduce expense. It is this condition that the national Committee on Industrial Rehabilitation is trying to capitalize in its campaign to modernize factory equipment, and the movement should have a strong appeal for the power companies.

For it is one thing to advocate industrial applications of industrial power or heat or air conditioning when times are good, with production booming and profits large. It is another thing when there are no profits and management is put to it to find new ways to make ends meet. No matter how sound the theory may be, it is hard to make men change their ways when all is well. But the breath of the wolf on the back of the neck stimulates thought and opens minds, and it makes good opportunity for salesmen. The fact that industrial load is down, therefore, does not mean that there is no work at present for the power sales department to do. On the contrary, it sets the stage in many cases.

The correction of power factor, the more economical application and control of motors, the introduction of electric heat where accurate regulation is important, the development of air conditioning in the chemical, food, textile and other industries where temperature or humidity are vital factors, the improvement of lighting where it will reduce the waste through spoilage—all these advantages have immediate money value today, as they affect the present volume of business. As such, they offer a new approach to many prospects.

The committee is striving to help toward reemployment and business recovery by stimulating the purchase of "capital goods," meaning machinery, equipment and plant facilities. It has a sound program. The fact that it ties so closely into their own objectives should win the enthusiastic support of all power companies.

Factors to consider in revising breaker ratings

THE great progress in oil circuit breaker development and performance made during the last three years has definitely brought to a head an opinion long held by many progressive engineers and executives in the electric power industry that the present OCO-2 min.-OCO duty cycle needs revision. That this has been recognized by both the manufacturers and users is evident from the recent formation of the joint N.E.L.A.-A.E.I.C.-N.E.M.A. committee to deal with this important problem. The only surprising thing is that this has been so long delayed.

There is another aspect of this question that needs clearing up. Even the most superficial investigation of the duty-cycle problem discloses the wide variety of uses made of, and interpretation given to, the present duty cycle. While probably intended as a testing cycle originally, it has during the past decade been used not only in that capacity but as a design specification, as a basis of guarantee of performance, as a base for derating for more rapid reclosure cycles, and as a guide and bogey for setting up inspection and maintenance schedules. Further, this one duty cycle has been used for the entire range of breakers from 5,000-amp., 600-volt rating to a rating of 1,200 amp., 230,000 volts. That a great deal of misuse of a perfectly well-inten-

tioned standard has resulted, with its consequent economic waste, must be apparent.

The committee, faced with the task of setting up a new cycle, has the opportunity not only of setting up a duty cycle that will fit each logical group of breakers but also of clarifying and co-ordinating the separate but inter-related questions of performance, guarantee, method of testing and operating inspection and maintenance routine. It would appear desirable, too, to give full consideration in the formulation of this duty cycle to such questions as recovery voltage and the rate of recovery voltage. Again, the new duty cycle ought to make possible, without too much sacrifice in the economic direction, of experimentation in, and development of, the more rapid reclosure cycles now very definitely evident as the trend of power system practice during the next decade. Finally, the duty cycle should, if possible, take into consideration and give assurance of that full mechanical reliability which should be so definite a part of every reliable circuit-interrupting device, but which, unfortunately, has not always heretofore accompanied very many breaker designs.

Study the Ithaca plan

ONE of the outstanding contributions to merchandising is the Ithaca plan described in the James E. Davidson N.E.L.A. prize paper by W. J. Cashman and F. S. Hoefer. This is a practical plan for co-operative merchandising that has produced results. It shows how an intelligent analysis of conditions in any area permits the electrical selling agencies to develop a co-operative and harmonious sales plan.

First comes a market survey to find out what has been sold, who sold the devices, the purchasing power of the market and the suggestions of all sales outlets. Next comes a survey of merchandising methods of other industries which try to get their share of the consumer dollars. Then it is possible to use these facts pertaining to the market area to develop a merchandising plan that will operate. This will differ in details in the several parts of the country, but the basic ideas in the Ithaca plan can and should be applied in all regions.

Competition and bickering between sales outlets are eliminated; concentration is had on the sales of load-building appliances; the utility sells, but also helps all other outlets to sell; utility sales executives act as sales executives for all outlets and are paid a salary plus a bonus based on total load-building sales by all outlets; full advantage is taken of co-ordinated advertising, campaigns, displays and promotion; sales quotas are established for all areas on a load-building basis; specialty selling is used where it is justified and the utility affords all possible sales aid to all outlets without introducing paternalism or removing the incentive for each outlet to sell. The Ithaca plan points the way to more business.

False economies in street lighting

MUNICIPAL expense slashing on behalf of the overburdened taxpayer should be done with discrimination if the remedy is not to become worse than the disease. At the recent convention of the Illuminating Engineering Society Prof. F. C. Caldwell presented a valuable paper on the economic value of good street lighting which deserves wide circulation among city and town authorities. The author gave evidence to prove that the cost of adequate urban street illumination on the basis of $2.50 per capita per year would produce an annual profit on accident and crime prevention of $88,000 per 100,000 of population. This is predicated on a present average street lighting cost of about $1.20 per capita and an added outlay for modernization of $1.30 per capita. For the country as a whole Professor Caldwell estimated that adequate street lighting would save $187,000,000 in accidents and $75,000,000 in crime costs.

The high percentage of crime committed after dark and the incidence of automobile accidents in investigations by various authorities lead to the conclusion that pennywise economies in this field of lighting spell dollar wastes in human misery. Higher traffic speed, increased usefulness of street areas at night, greater attraction of business areas, faster runs by fire departments and consequent reductions in fire losses, savings in gasoline —these are some of the indirect benefits of good lighting which should be in the scales when budget makers weigh the accomplishments of tax money.

2½ Years' Experience With 1,350-Lb. Steam Plant

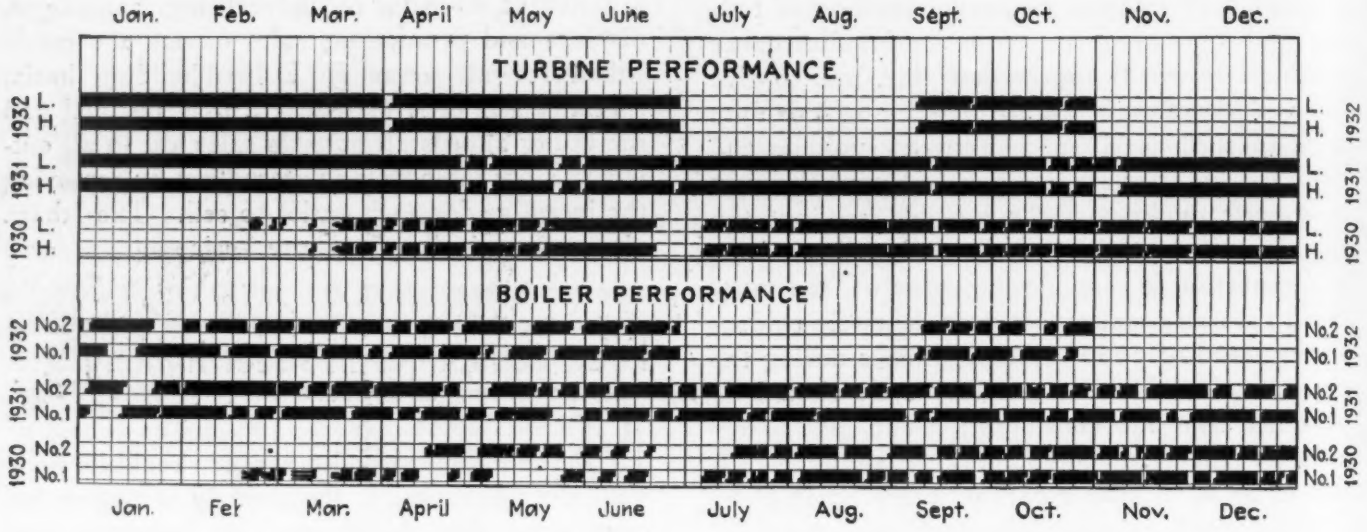

Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.
TURBINE PERFORMANCE
1932 L. H.
1931 L. H.
1930 L. H.
BOILER PERFORMANCE
1932 No.2 No.1
1931 No.2 No.1
1930 No.2 No.1
Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.

Fig. 1—Record of turbine and boiler performance

The jogs in the continuity-of-service bars are due to the fact that each bar represents three shifts, and that the resumption or interruption of operation may have started or terminated with less than three shifts.

"WITH a plant radically new in design and with many untried features, it is evident that some difficulties would be encountered and would have to be rectified." These were the words‡ of E. M. Gilbert, president W. S. Barstow & Company, designers and builders of the Gilbert station, back in 1931. At that time he described various unusual elements in the plant which introduced occasional operating difficulties and the ways in which these difficulties had been met up to the time. After nearly four months of initial operation the station was taken out of service for about two weeks at the end of June, 1930, for the purpose of making the changes that seemed to be required to remedy these initial difficulties. All of them were concerned with details of design or manufacture, but none of them indicated any original error in the engineering principles followed in the design of the station.

Subsequent to this outage for intentional readjustment, beginning July 6, 1930, for a period of two years lacking about one week, to June 27, 1932, the station gave continuous service without interruption except for occasional week-end shutdowns, many of which were ordered by the system load dispatcher.

During the summer of 1932, between June 27 and September 8, the station was entirely out of service by reason of an accident to the blading of the low-pressure turbine unit, a satisfactory explanation of which has not yet been found. Since resumption of operation, on September 8, the station has again operated continuously except for Sunday shutdowns.

The accompanying charts show the performance of the turbine and boiler units since the station was started in March, 1930.

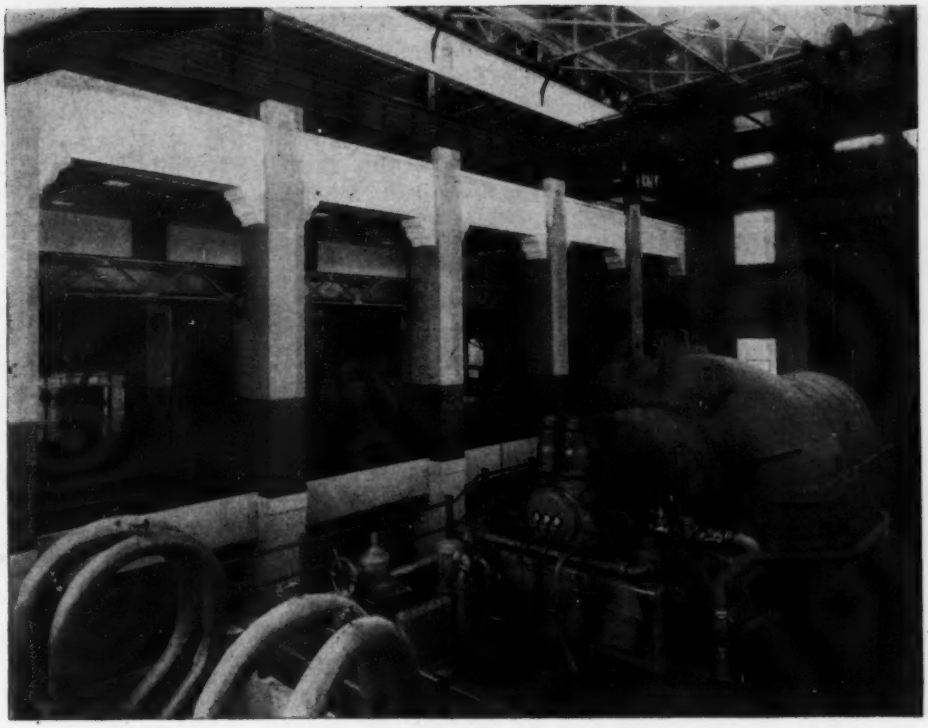
The chief point of interest about the data on the operating availability of this station is the effect that the use of 1,350-lb. steam pressure in regular service has upon the integrity of the appliances either subjected to that pressure, or made necessary because of the employment of 1,350 lb. as distinct from the lower pressures more commonly used.

It is only a few years since 400-lb. plants were a decided step in advance of the 200 and 300-lb. plants which previously constituted the backbone of all large utility systems depending upon steam power, but it did not take long to overcome the practical difficulties that 400 lb. introduced over 200, and by the time the Gilbert station was being planned 400-lb. practice was so near being standardized that use of that pressure was not regarded as involving any unusual hazards to continuity of operation.

But the jump from 400 lb. to 1,350, although not involving any considerable increase in steam temperature, nevertheless introduced more factors which required special reckoning with in order to insure equal reliability in operation. All parts of boilers, water walls, economizers, steam and feedwater piping, feed pumps, etc., had to be designed afresh in all their details, and a great deal of pioneering had to be undertaken on the same old basis of trial and error which has been a part of steam engineering ever since the days of James Watt.

‡*"Electrical World," December 6, 1930, page 1044; January 10, 1931, page 100; July 30, 1932, page 140; A.S.M.E. Journal, December, 1930.*

By J. A. POWELL*
and G. T. DEMPSEY†



No dividing wall exists between turbine and boiler rooms, facilitating supervision of both with fewer operators

The elements of the plant whose continuity of service is particularly affected by the 1,350-lb. pressure are the boiler and its accessories, the boiler feed piping and pumps, superheater, the reheater, the economizer, the high-pressure turbine and its accessories and the main steam header with its subsidiary high-pressure piping.

In this review neither the fuel preparation and handling system, nor the draft equipment, nor the condensing equipment are regarded as being affected by the increase of the working pressure to 1,350 lb., as any difficulties which might arise in their operation are common to all large-scale utility power plants.

The high-pressure steam piping is, of course, inherently affected by the high boiler pressure both in design and in regular operation. Fluctuations of temperature with varying load make more differences in the expansion and contraction than are met with at the hitherto standard lower pressures, and the design of the joints calls for greater care for the prevention of leakage than is required at lower pressures, independently of the greater strength called for by higher pressure.

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In turbines the high-pressure unit alone is directly affected by the higher pressure, in so far as the cylinder casing, blading and spindle, the governor mechanism and valves and the packing of the glands are concerned.

The low-pressure turbine unit differs in no essential respect from any standard 400-lb. turbine of equivalent size, except that its governing mechanism is necessarily tied up with that of the high-pressure unit, against emergencies in which the low-pressure unit may carry its load with the high-pressure unit out of service. There are now many 400-lb. turbines in use, these sizes running up from 75,000 to 100,000 kw. for single cylinder and large compound units up to 160,000 kw.

In spite of all the care that is taken in design by manufacturers and in installation and operation by experienced users of steam power equipment it is well known that certain allowances for unpredictable failures have to be

Some Features of Gilbert Station

The Gilbert station of the New Jersey Power & Light Company at Holland, N. J., began regular operation in supplying power to that system March 2, 1930. This was one of the first 1,350-lb. steam-pressure stations designed to operate regularly on variable loads like any other utility power plant. The outstanding features of its design have been described§ and the practical side of its operation between March and November 15, 1930, have been discussed.‡

This station, which was designed ultimately to comprise four units of the type described, now generates power in a single initial turbo-generator unit of 55,000 kw. of the cross-compound type, the high-pressure turbine being of 11,800 kw. capacity at 3,600 r.p.m. and the low-pressure turbine of 43,200 kw. at 1,800 r.p.m.

The single turbine unit is supplied with steam by two boiler units, each designed to furnish 250,000 lb. of steam per hour at a pressure of 1,350 lb. The high-pressure turbine takes steam at 1,250 lb. and 750 deg. F. and expands it down to 400 lb. and about 540 deg. F. at full load, and at lighter loads to as low as 200 lb., the steam being reheated to 750 deg. F. for use in the low-pressure turbine, whence it goes to a single-pass condenser having 31,600 sq.ft. of cooling surface, where it is finally expanded to 29 in. vacuum.

Each boiler unit is fitted with a superheater, a steam reheater, a gas reheater, an economizer and an air preheater. The furnaces are of the fin-tube water-wall type, burning pulverized coal, heat being liberated at about 18,000 B.t.u. per cubic foot per hour. The coal runs approximately 14,000 B.t.u. per pound with an ash content not in excess of 7 per cent.

Boiler feedwater is handled by two pumps in series for the boiler units, the primary pump delivering water to the secondary pump through the entire series of heaters, against a pressure of about 700 lb. per square inch, while the secondary pump delivers this hot water at a pressure of approximately 1,500 lb. through the economizer to the boiler.

§*"Electrical World," March 2, 1929, page 429; "Power," March 28, 1929, page 859; "G. E. Review," February, 1929; "Power Plant Engineering," March 1, 1929.*
‡*See footnote on page 716.*

carried along as mental reservations in the design and operation of even the very best station equipment that can be purchased and assembled. This applies to the design and operation of the best standard 200-lb. or 400-lb. turbines, as well as, for example, to the various forms of tubing which are inherently necessary as constituent pressure parts or elements of boilers, superheaters, reheaters, economizers, feedwater heaters and condensers, all the way through the steam and water cycles.

In spite of all manufacturing and operating precautions, a hidden flaw or an unforeseen condition involving corrosion or temperature expansion and contraction, or the non-suitability of some supposedly first-class material thought to be appropriate, may and often does shut down a piece of equipment that has either been standardized for years or has been carefully designed on the basis of long experience. Such shutdowns are the common lot of power plants operated at the old standard lower pressures, as every operator knows, and it is a remarkable fact that since the "shaking-down" period, as it might be called, of the Gilbert plant prior to early July of 1930, the proportion of outage that was caused by defects in supposedly standard equipment has been about two and one-half times as great as the proportion of outage that was due to the equipment this station affected by high pressure.

1,350-lb. troubles and remedies

It will be interesting to review briefly some of the operating conditions which are incident to the use of 1,350-lb. working steam pressure. In the first place, obviously, all pressure parts must be proportionately thicker in order safely to withstand the increased pressure, and while the steam temperature is no higher than that reached in many installations of superheated steam at lower pressures, the heavier material tends greatly to increase the quantity of stored heat in the steel drums, headers and tubes of the boiler and the water-wall furnace structure, as well as the inclosing walls of the boiler setting, which requires a longer time for raising the boiler from a cold condition to its operating temperature, and also requires a proportionately longer time for cooling down after being taken out of service.

This is quite different from the practice sometimes observed in steam standby plants, where, under the old 200-lb. pressure system, it is possible to place a 600-hp. boiler on the line in 25 to 30 minutes from a cold start.

But the Gilbert station is in no sense a standby plant: it is primarily intended as a firm-load plant and has been functioning as such ever since regular operation began. This does not mean that the load does not fluctuate: The design of the plant is such that although capable of continuously putting out about 55,000 kw., it can give excellent economic results with two boilers in service from that output down to 30,000 kw., at which output one boiler is cut out. Below this, down as low as 12,000 kw., one boiler unit can operate the plant economically at less than one-quarter of the plant rating. Below 12,000 kw. it is the practice to cut the plant out altogether, as system load conditions make that the cheapest thing to do, and this happens occasionally on Sundays.

Engineers responsible for steam power plant operation are well aware of the necessity for allowing ample time for warming up the large steam turbine units now in common use, and this is just as necessary in the case of a 200-lb. or a 400-lb. turbine, with higher temperatures, as when higher pressures are employed. In fact, when one considers the difference in the lengths of the turbine spindles exposed to heat (which in the case of the 1,250-lb. unit is possibly 3½ ft., and in the case of a 400-lb. low-pressure unit 8 to 9 ft.) and even more marked differences in the diameters of the turbine blading, the risk of warping or distortion of the turbine spindle, due to the warming up for a start or cooling down after a run, would appear to be much greater with the low-pressure unit than with the high-pressure unit of a compound turbine.

From this standpoint therefore the use of 1,350 lb. seems to offer no disadvantages as compared with the low pressures previously standardized. There is one feature, however, directly resultant from the 1,350-lb. pressure which called for special treatment at the Gilbert station, and that was the stretching of the bolts holding together the two halves of the turbine cylinder. The original bolts, having a strength of 40,000-lb. tension, were replaced by stronger bolts of 60,000-lb. tension in order to keep the cylinder tight.

The blading of the high-pressure unit has given no trouble whatsoever. The blading trouble which shut the plant down for 72 days occurred altogether in the 400-lb. low-pressure unit and might have happened to a 400-lb. turbine of the same size anywhere in the world.

Concerning the governor mechanism, Mr. Gilbert's paper of December, 1930, mentions the necessity for replacing with bushings of "nitralloy" the original cast-iron bushings through which operate the valve stems of the turbine governor mechanism. The replacement of cast iron with the material mentioned has proved quite satisfactory ever since the change was made, and this difficulty, which was for a time quite serious, has been 100 per cent cured, as was also the trouble which caused the change in design of the cam shaft and cam arms so as to use the shaft merely as a bearing and transmit the strains directly through the cams.

Subsequent to the date of Mr. Gilbert's paper there was continued trouble from the governor not acting quickly enough when the load was suddenly thrown off by lightning, causing overspeeding of the turbine. The final method[1] adopted for curing this difficulty had to be applied entirely outside of the plant, and its final rectification consisted in changing or readjusting all relays on the transmission system, as the remedy for inherent system instability. Since this was done the governor has been relieved and parts of the system affected by lightning have cut themselves out automatically, without causing sudden cutting off of the entire plant load. Obviously this particular difficulty was not caused by 1,350-lb. steam pressure, though the effects on the plant operation were somewhat aggravated by it.

There was one unforeseen difficulty involving the design of the economizer connections which had rather far-reaching results. Reference has been made to the greater length of time required for warming up the boiler units of this plant, as compared with boilers operating at the familiar lower pressures. As the economizer receives gases from the boiler outlet which are relatively hotter than is the case with plants designed for lower operating pressures, the water contained in the economizer was very quickly heated up during the period of bringing the

[1] *"Electrical World," July 30, 1932, page 140*

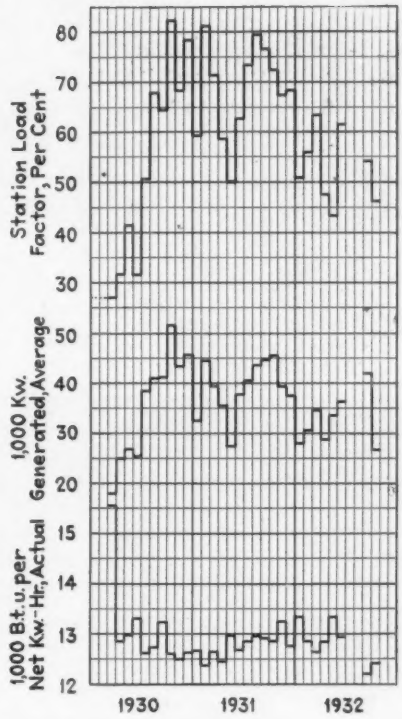

Fig. 2—Load factor, load and heat economy

Note that the station load factor has varied between 82 and 44 per cent since October, 1930. During the same period the average power developed ranged from 52,000 to 26,000 kw., and the B.t.u.'s per net kilowatt-hour from 12,200 to 13,300. B.t.u. content of coal is based on mine weights, so the actual economy ranges from 11,880 to 12,950 B.t.u. per net kilowatt-hour.

boiler up to pressure, during which period there is no circulation between economizer and boiler, as no appreciable amount of steam which requires water replacement is delivered from the boiler.

Hence the contents of the economizer were very quickly converted to steam and had to be replaced by water, which had the effect of causing rapid temperature changes in the economizer, making it leak. This leakage continued after the boiler got into continuous operation and overworked the evaporator, ultimately causing higher concentration of solids in the boiler than is normal, which, in turn, caused deposits of solid matter on the turbine blading.

This whole chain of difficulties was corrected by the simple expedient of installing a connection from the lower portion of the boiler direct to the bottom of the economizer, which thus created a circulation in the economizer during the warming-up period. This circulation kept the economizer full of water, stopped the leakage between the economizer tubes and headers, relieved the evaporator of its extra duty, introduced water of normal concentration into the boiler and solved the whole problem.

Considering the high-pressure steam piping, it was found necessary, after some months of operation, to increase the flexibility of each 8-in., 1,350-lb. main steam line, by inserting a return bend, in order to reduce stresses in the joints in the pipe which had caused intermittent leakage. The substitution of the new bends was accomplished within the week-end shutdown period in the case of each boiler, and the absolute freedom from joint leakage subsequent thereto has proved the correctness of the remedy employed for this particular trouble.

Mr. Gilbert's paper mentioned occasional leakage on 1,350-lb. piping less than 2 in. in diameter where the exigencies of operation caused the joints to be subjected alternately to high and low temperatures, resulting in leaky gaskets, even though the gaskets had been made of metal. The method of stopping this leakage, referred to in Mr. Gilbert's paper, of replacing flanged fittings with small forged fittings which are screwed onto the pipe and then welded, has continued to be satisfactory.

Another element made necessary by the 1,350-lb. pressure system, though not itself subjected to 1,350-lb. pressure, is the gas reheater, built into each boiler unit, which reheats the steam exhausted from the high-pressure turbine, on its way to the low-pressure turbine. Mr. Gilbert recorded the fact in his 1930 paper that when the plant was started the reheat temperature was found to be entirely too high and that the remedy employed was to remove reheat surface from both boiler units. This cured the trouble so far as the heat problem was concerned, but some months afterward the reheater had to undergo repairs which required the replacement of three tubes. Steam passes through these tubes at about 400-lb. pressure and one of the tubes had a minute pinhole, probably an original defect, which was so small that the steam which escaped from it did not make noise enough to be heard, and it was not until this escaping steam had eroded the walls of two adjacent tubes sufficiently to cause an audible roar of the escaping steam that the operating staff discovered what was wrong. Since the replacement of these three tubes no difficulty has been experienced with the gas reheater.

The minor difficulties which came up from time to time during early operation in the induced-draft-fan installation and in the coal-pulverizing equipment were not inherently tied up with the use of 1,350-lb. boiler pressure. Neither the coal-pulverizing equipment nor the fan equipment has ever failed to an extent that required the boiler plant to be shut down and the turbine operation stopped. The abrasion of the fan vanes appears to be an unavoidable consequence of the use of pulverized coal, because a large proportion of the ash goes through the fans instead of into the ashpit. Though very finely divided, its composition of practically 100 per cent silicates makes it highly abrasive, and vane replacements in the induced-draft fans are to be looked for periodically in any pulverized coal installation. The problem of quick repairing of abraded fan blades is solved at this station by keeping spare fan material on hand, ready for quick substitution.

The use of the steam reheater has been discontinued as mentioned in Mr. Gilbert's paper, because the gas reheater has proved to be ample for all requirements, except at very light loads.

The secondary boiler feed pumps were mentioned by Mr. Gilbert as having given some trouble, which was chiefly in the gland seals. Replacement of the original seals by a combination labyrinth and stuffing box packing has been generally satisfactory. Either of the secondary feed pumps is capable of delivering water to both boilers simultaneously, so that in the occasional event of either one of the regular secondary feed pumps getting into difficulty a shutdown from such failure has invariably been prevented. The pumping of water at a temperature in excess of 400 deg. F., against a static pressure of around 1,500 lb. per square inch at the rate of the order of 1,000 gal. per minute, involves some of the most difficult mechanical problems in the entire plant, but as the installation of spare feed-pump equipment was foreseen as a necessary safeguard, none of the outages has been chargeable to this particular item.

The feedwater question is a very insistent one in all modern boiler plants, regardless of whether the pressure is 200 or 1,350 lb. This is due to causes inherent in the development of modern water-wall furnace boilers which generate steam at so much greater rates per square foot of heating surface than were common up to only ten or

twelve years ago. The quality of the feedwater at this station was discussed in Mr. Gilbert's paper, and while the problems which concern the evaporator were very satisfactorily solved by a baffle plate and changing the method of control, advances in the art of making steam and maintaining boilers under high rates of evaporation are pointing to the necessity of further refinement in the treatment of feedwater both outside and inside the boiler, for the protection of the feedwater piping and pumps, as well as for the protection of the boiler surfaces and the turbine blading. Up to the present time no outages have been caused at Gilbert station by lack of foresight or of operating attention with respect to the purity of the feedwater, but it has been necessary to reduce the concentration in the boiler drum to 200 parts per million.

In the accompanying tabulation are given in condensed form the percentages of availability of the Gilbert plant since its operation began, reckoned from the accompanying chart according to three different aspects.

Availability of the plant as a whole, on the line, and not individual availability of either the boiler or turbine units

	Hours Elapsed	Hours* Repair Outage	Hours Available	Percentage Availability
1. From March 2, 1930, to October 31, 1932, inclusive	23,400	3,851	19,549	83.7
2. From July 7, 1930, to October 31, 1932, inclusive	20,351	2,555	17,796	87.5
3. From July 7, 1930, to July 7, 1932, inclusive (two years)	17,544	1,097	16,447	93.8

*"Hours Repair Outage" refers to the hours lost by deliberately shutting down the plant to repair defects to the steam equipment.

The first aspect covers the entire period of operation from March 2, 1930, to October 31, 1932. The second aspect cuts out the "shaking-down" period prior to July 7, 1930, by which time the preliminary wrinkles in operation were judged to have been smoothed out and the station placed in dependable condition. The period covers from July 7, 1930, to October 31, 1932. The third aspect covers the period of exactly two years from July 7, 1930, to July 7, 1932. This period ran about nine days into the long outage period that was due to the low-pressure turbine blading failure, but this long period of practically continuous operation approached so nearly to the equivalent of two calendar years that it is thought worth while to make a separate exhibit of it.

During the period from July 7, 1930, to October 31, 1932, the total outage for repairs was 2,555 hours. Of this, 1,825 hours was due to the low-pressure turbine (condenser included), and only the remaining 730 hours was chargeable to repairs in the high-pressure equipment, which includes the boilers and their accessories (as previously described), the 1,350-lb. piping and the high-pressure turbine.

The outage is thus in the proportion of 28.6 per cent for high-pressure repairs and 71.4 per cent for low-pressure repairs; in other words, the low-pressure repairs called for about two and one-half times the outage taken up by high pressure repairs. Some of the shorter week-end shutdowns, lasting from one to three days, were ordered by the load dispatcher for system reasons. One of the boilers was sometimes shut down over a week-end because there was not load enough to warrant operating it.

Figures showing the availability of boilers and turbines separately from March 2, 1930, to December 31, 1931, only have been worked out by the operating department and are submitted in the following table; they include the early "shaking-down" period prior to July 7, 1930:

Unit	Per Cent Availability
No. 1 boiler unit	83.6
No. 2 boiler unit	80.2
High-pressure turbine	87.4
Low-pressure turbine	97.7

The number of times in the year 1931 that main equipment units were started and stopped was as follows:

Unit	Times Started and Stopped
High-pressure turbine	9
Low-pressure turbine	10
No. 1 boiler unit	19
No. 2 boiler unit	23

Continuous runs of both the high-pressure and low-pressure turbine units without shutting down, as read off the chart, are as follows:

Period	Duration (Days — Hours)		Duration (Hours Continuously)
1. Dec. 21, 1930, to April 23, 1931	113	8	2,742
2. June 29, 1931, to Sept. 11, 1931	75	8	1,808
3. Nov. 8, 1931, to Mar. 31, 1932	144	8	3,464
4. April 3, 1931, to June 28, 1932	87	8	2,096

Gilbert station commonly carries the base load of 45,000 to 55,000 kw. continuously except during week-ends. Besides being connected with the West Reading plant (69,000 kw.) and Middletown plant (65,000 kw.) there are interconnections with neighboring systems on the north, east and south totaling about 135,000 kw. if all were called into service to their full interconnection capacity, but usually not more than one-quarter to one-third of this is ever exchanged at any one time. The system output during a recent twelve-month period is a little under 800,000,000 kw.-hr. per year, of which about 300,000,000 is generated by Gilbert station.

Summary

From what precedes, it is obvious that the major difficulties inherent in the use of the working steam pressure of 1,350 lb. which were encountered in the Gilbert station are, after all, not very numerous and have been responsible for a much smaller proportion of the total outage than have the troubles common to lower pressure plants.

The economic reasons for the adoption of 1,350-lb. pressure have not lost any of their force in the meantime, and the original justification of this pressure still holds good.

The low production cost of about 12,000 B.t.u. per net kilowatt-hour is a decided advantage in the daily interchanges of secondary power with other utility companies.

The 72 days' shutdown during the past summer was due to a cause that is likely to afflict any 400-lb. turbine to a greater degree than the 1,350-lb. unit of the turbine at the Gilbert station.

The engineers responsible for the design, equipment and operation of the Gilbert station have every reason to be satisfied with its record in the past, in so far as that record may affect the outlook for similar types of plant construction in the future.

Central-Station Operations Improve

SEPTEMBER reports of the operations of electric light and power companies reveal the usual rise in revenue at this season of the year, with the additional feature of a somewhat closer approach to last year's figures than in any other month since April. Compared with September, 1931, there has been an average loss of 7.5 per cent, the total for the industry being $159,040,000, including estimated revenue for companies not reporting, against $171,930,000 a year ago. The loss in August was 9.3 per cent; in July it was 8.9 per cent.

Operating and maintenance expenses, exclusive of taxes, depreciation and interest charges, were down 9.1 per cent to $68,410,000, from $75,300,000 for the same month in 1931.

Energy output, 6,301,229,000 kw.-hr., was virtually identical with that of August, but the average daily output was higher by 3 per cent. Taking Sundays and holidays into account, the production per working day in September was 252,000,000 kw.-hr., or 7.5 per cent more than the 233,000,000 kw.-hr. in August. Compared with September, 1931, there was a decrease of approximately 11 per cent. Output from water power was about 10 per cent greater and from fuel almost 20 per cent less than a year ago. The proportion of hydroelectric energy remains high—more than 35 per cent of the total.

Regionally the revenue was everywhere less than in 1931. New England came closest, cutting the disparity to 4.4 per cent. An appreciably closer approach is indicated also in most other areas, particularly in the Middle Atlantic States and on the Pacific coast. The fact that the gain from August somewhat exceeded that recorded in 1931 seems to indicate an improvement in the sales of industrial energy, in addition to the usual increase for lighting. The only region in which the per cent decrease from 1931 was greater than in August was the Mountain region, presumably because of the continued inactivity in mining.

Energy production, like revenue, was everywhere less than a year ago by fairly wide margins, as is evident from Table II. In several regions the output was smaller than in August; in the East North Central and Middle Atlantic states there was a small increase. The only really important gain occurred in New England and amounted to 9 per cent.

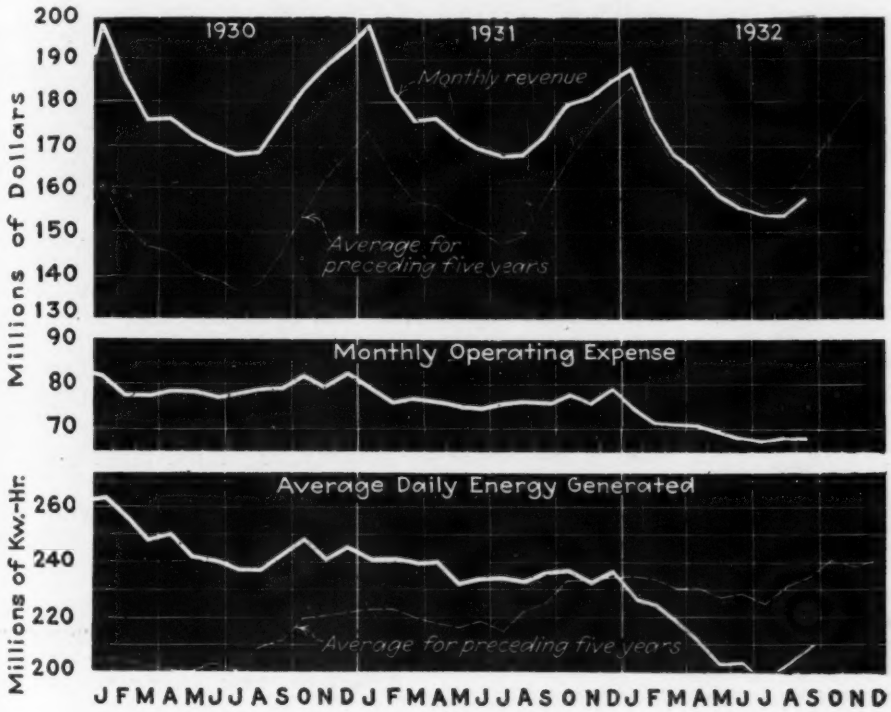

Table I—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1932	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
June	6,133,468	—12.6	2,500,204	— 5.2	3,633,264	—17.2	1,643,000	— 9.7
July	6,102,481	—15.7	2,495,937	— 0.3	3,606,544	—24.2	1,714,000	—10.0
August	6,303,229	—12.0	2,385,220	+ 5.4	3,918,009	—20.0	1,840,000	— 1.2
September	6,301,591	—11.2	2,233,358	+ 9.9	4,068,233	—19.8	1,876,000	+ 1.0

Table II—Regional Operation, Revenue, Energy Output, in September, 1932

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	159,040	— 7.5	6,301,591	—11.2	2,233,358	+ 9.9	4,068,233	—19.8
New England	16,740	— 4.4	453,732	— 6.8	176,285	+ 2.5	277,447	—12.2
Middle Atlantic	40,740	— 5.3	1,615,266	— 8.0	361,564	— 3.3	1,253,702	— 9.1
East North Central	35,950	—10.3	1,408,250	—12.6	116,684	— 3.3	1,291,566	—13.3
West North Central	13,570	— 8.2	422,194	—11.2	83,886	— 0.3	338,308	—13.7
South Atlantic	17,450	— 7.3	709,486	—13.8	336,762	— 7.7	372,724	—18.8
East South Central	5,430	—11.3	260,966	— 7.5	207,682	+ 4.9	53,284	—36.7
West South Central	9,610	— 6.6	357,925	—12.8	4,991	+23.0	352,934	—13.2
Mountain	3,880	—12.3	195,205	—19.5	147,841	—15.5	47,364	—32.8
Pacific	15,670	— 7.8	878,567	—13.7	797,663	+47.3	80,904	—83.0

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station operations.

Table III—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

Month	Total Gross Revenue from Sale of Energy*		Total Operating and Maintenance Expense†	
	1932 Thousands	Per Cent Inc.	1932 Thousands	Per Cent Inc.
June	$154,960	— 8.0	$67,510	— 9.3
July	152,370	— 8.9	66,410	—11.6
August	152,020	— 9.3	68,370	— 9.5
Sept	159,040	— 7.5	68,410	— 9.1

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.

†Does not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions.

Water-Heater Demands on System

By C. P. RANDOLPH and L. F. BERG

Chief Engineer and Water Heater Engineer
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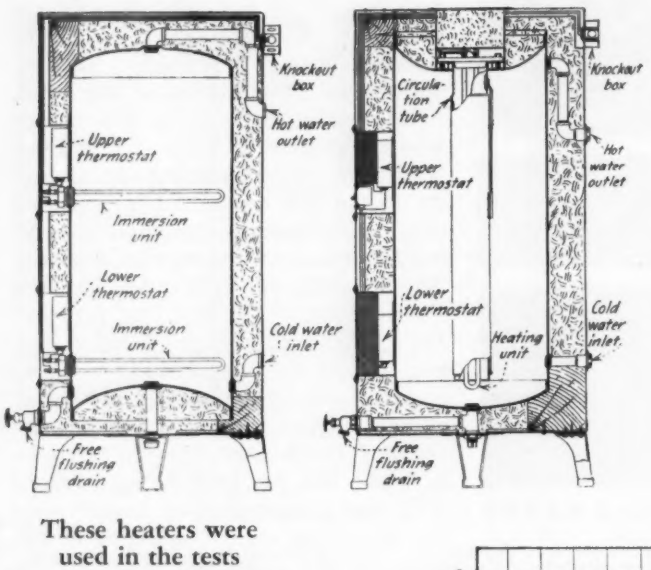
INVESTMENT per customer for electric water heating must be a minimum if an important saturation of this load is to be developed. However, there are such widely different domestic water-heating systems in use today that the variation in the utility investment to serve the water heater—for the same hot water service—is from $15 to $300 per customer. These figures are the extremes, neither is a practical solution of the problem; somewhere between them lies the answer.

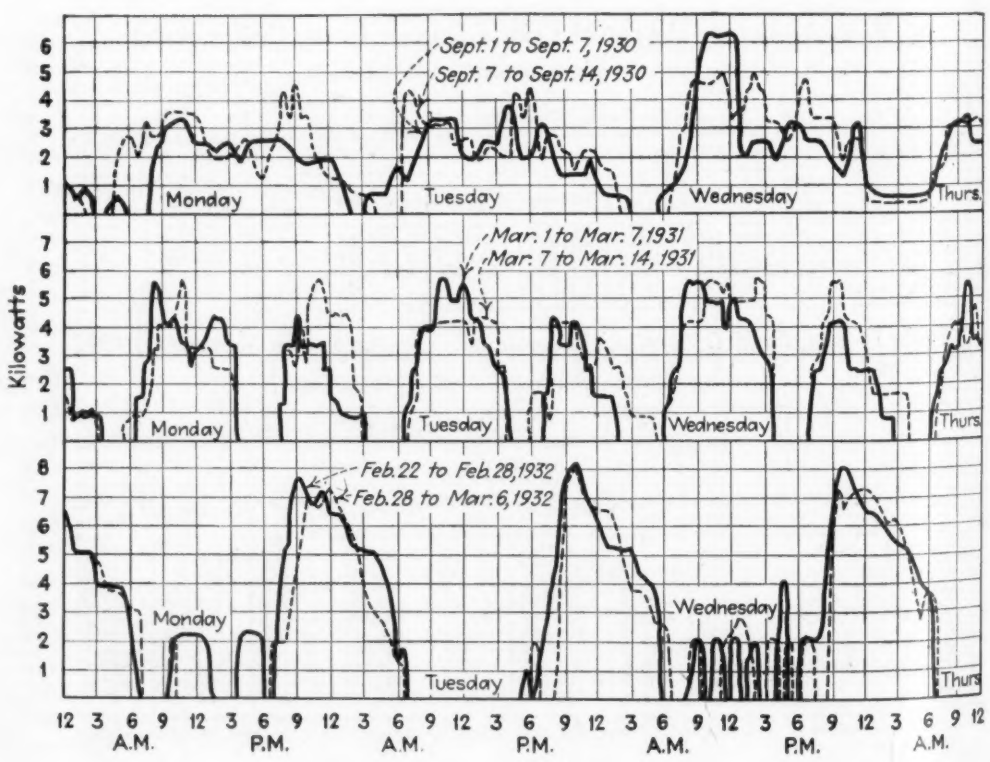
To determine the capital ultimately required to serve electric water heating customers it is necessary to know (1) the existing (and estimated future) characteristics of the load carried by the generating and distributing equipment of the utility, and (2) the characteristics of the proposed water-heating load. Existing utility load characteristics vary with local conditions; therefore, we may not expect one water heating system to be the most economical for all utilities. The daily water-heating load curve can be made to take almost any desired shape to meet local requirements. This is accomplished by the design of the water heater itself and by using some form of automatic control, such as time switch, carrier-current control, etc., in the energizing circuit. But we may say that all local requirements can be broadly met by three water-heating systems—24-hour charging, twenty-hour charging and ten-hour charging. There are, of course, many possible variations in each of the above three systems, but in the interest of simplicity the variations may be considered as subdivisions of the three broad divisions.

A water-heating system has to meet requirements—in addition to minimum investment—as follows: Satisfactory hot water service to customer, maximum con-



These heaters were used in the tests

They are of the twin-unit type to insure flexibility to meet the widely varying daily demands for hot water that occur in all homes; to secure maximum use of energy at night, and at the same time avoid excessively large tanks. The twenty- and ten-hour systems require, of course, a time switch which cuts off the lower unit for four and fourteen hours respectively. The upper thermostat on the water heater for the ten-hour system is of the double-throw type, cutting off the 1.25-kw. lower unit whenever the 2-kw. upper unit is on, thus substantially reducing the demand otherwise likely to occur at 10 p.m. and for several hours following.


Sept. 1 to Sept. 7, 1930
Sept. 7 to Sept. 14, 1930
Monday
Tuesday
Wednesday
Thurs.
Mar. 1 to Mar. 7, 1931
Mar. 7 to Mar. 14, 1931
Monday
Tuesday
Wednesday
Thurs.
Feb. 22 to Feb. 28, 1932
Feb. 28 to Mar. 6, 1932
Monday
Tuesday
Wednesday
Thurs.
Kilowatts
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A.M. P.M. A.M. P.M. A.M. P.M. A.M.

Diversified demands as at

These curves show demands per customer. demands at substations, i.e., upper, 24-hour sys-

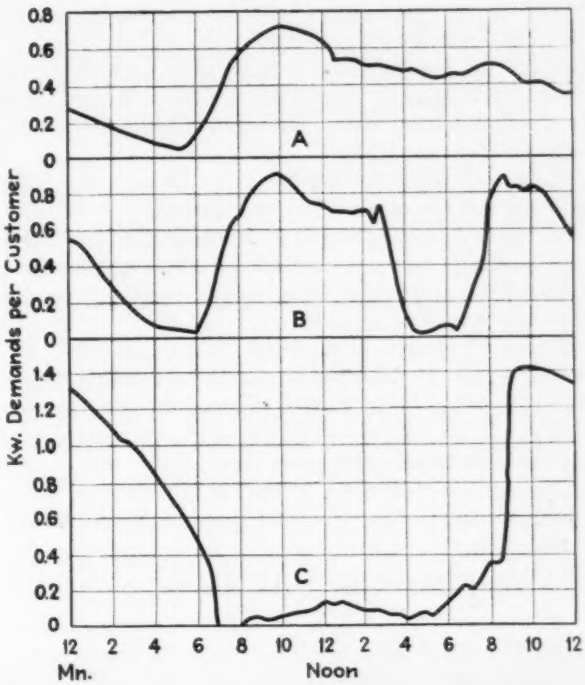
Are Not Burdensome

Field studies show diversities of demand appearing at substation to be as high as three to one and at distribution transformers between one and two for two-unit heaters with charging units on for ten, twenty and twenty-four hours.

venience, fully automatic operation, minimum installed cost, high efficiency, floor space, floor load and outside dimensions within practical limits, maximum freedom from service costs and pleasing appearance of equipment. This article deals only with water-heater load characteristics, but in developing the tank-water heaters used for these tests all the above requirements were given due weight.

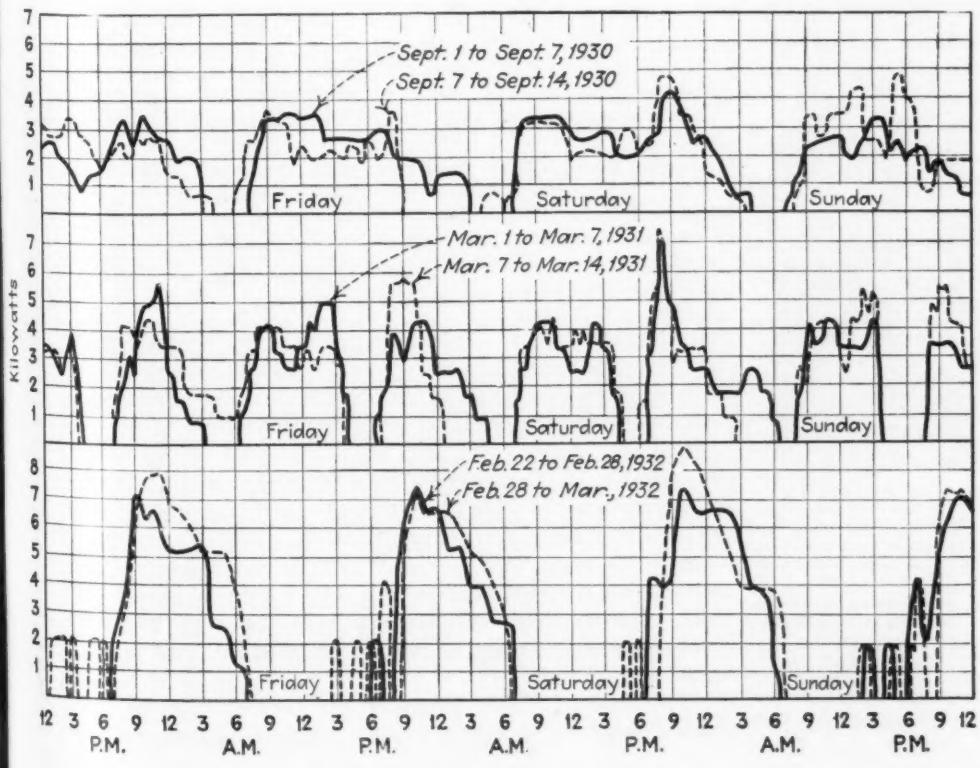
In order to determine the load characteristics of each of the three water-heating systems, complete tank heaters were installed in homes in suburbs of Chicago and equipped with the necessary meters, etc. Thermostats were set to deliver 145 deg. F. water at tank outlets. The homes were chosen as representative average families in the class ordinarily accustomed to automatic hot water service and able to pay $3 to $6 per month for such service. The tests of the 24-hour system were run in the fall and early winter; on the twenty-hour in winter and on the ten-hour in later winter and spring.

The tests on the 24-hour and twenty-hour systems were made in six homes, average number of rooms 7.5; number of persons, 4.5; one bath per home; two homes had one servant each, and laundry was done at home in all except one. For the ten-hour test there were five homes; average number of rooms, 7.8; number of persons, 5.0; one bath per home; two homes had one servant each and laundry at home in all five.



distribution transformers

They follow the same order as the curves for tem; center, twenty-hour, and lower, ten-hour.



Demands per customer at substations of these orders

(A) 24-hour system—30-gal. tank; twin-unit water heater; lower unit 0.60 kw. and upper unit 1.50 kw. Average of 420 customer-days. No time switch. Average energy consumption 306 kw.-hr. per month per customer.

(B) Twenty-hour system—30-gal. tank; twin-unit water heater; lower unit 0.75 kw. and upper unit 1.50 kw. Average of 420 customer-days. Time switch cuts off lower unit 4 p.m. to 8 p.m. daily. Average energy consumption 359 kw.-hr. per month per customer.

(C) Ten-hour system—66-gal. tank; twin-unit water heater; lower unit 1.25 kw. and upper unit 2.0 kw. Average of 350 customer-days. Time switch cuts off lower unit 7 a.m. to 9 p.m. daily. Average energy consumption 356 kw.-hr. per month per customer.

To obtain the curves indicating diversified demand per customer at the substation, 70 daily load curves for each home were added and averaged. These curves for the 24-hour and twenty-hour systems were taken in six homes and are therefore the averages of 420 customer-days, and for the ten-hour system in five homes, 350 customer-days. For the curves indicating transformer demands five individual customer load curves were added; two weeks are shown for each of the three systems, as it was found that additional weeks gave no more information.

Ordinarily it is not good practice to arrive at diversified demands by combining daily load curves of so few customers as we have used here. It does appear, however, to be sufficiently accurate for low-wattage water heaters, when the customers are carefully chosen, because of the inherently high load factors of the individual heaters. It is unlikely that a larger number of customers would show any appreciably increased diversity effect.*

The average kilowatt-hours as shown in Table I are approximately what field experience† has shown the average six- to eight-room home will use (350 kw.-hr. per month), but are not to be taken as measuring the relative energy consumption of the three systems, because the variation from one test to the next in the quantity of hot water used by the customer destroys all possibility of accurately comparing energy consumption. The relative efficiencies (energy consumption) of the three systems were measured carefully under controlled laboratory conditions when delivering 1,285 gal. of 145 deg. F. water per month, cold water at 45 deg. F., etc., and are practically identical. See Table II.‡

Tank sizes and connected loads

The tank sizes—and corresponding connected loads—used in the above tests were designed to fit the requirements of the "average" customer, with four to five persons in the family, using 1,000 to 1,400 gal. of hot water per month and consuming about 350 kw.-hr. per month. Hot water requirements, of course, vary greatly between different homes and, therefore, for any given water-heating system a range of tank sizes must be available to meet these variations between different homes. By holding the ratio of connected load to tank size constant for all tank sizes (for a given water-heating system), the shape of the diversified load curves will be as shown in the graph of substation demands, regardless of the variations in tank sizes required by a group of actual customers (provided only, that each water heater is roughly of the correct size for the home in which it is installed). Or, to state it more accurately, the diversified demand (at any time of the day) per kilowatt-hour consumed per day will be as shown in the substation demand curves for all domestic customers, even though there is great variation between different customers in quantity of hot water (and kilowatt-hours) used per month.

The data of Table IV show the correct ratio of connected load to tank size for each water-heating system.

Table I—Energy Consumption for Water Heating

Kilowatt-Hours per Month

Customer	Twenty-four-Hour Charge	Twenty-Hour Charge	Ten-Hour Charge
1	285	302	267
2	307	348	...
3	317	346	363
4	378	463	447
5	251	291	...
6	300	406	265
7	...	...	440
Average	306	359	356

Table II—Heater Efficiencies as Disclosed by Tests

System: charging time, hours	Twenty-four	Twenty	Ten
Efficiency (at tank outlet) per cent	93.0	92.5	93.0
Kilowatt-hours per month	336	338	336

Table III—Summary of Tests in Six- to Eight-Room Houses

Charging time, hours	Twenty-four	Twenty	Ten
Type of water heater	"Vertiflow"	"Vertiflow"	Plain
Tank size required, gal.	30	30	66
Connected load, lower unit, kw.	0.60	0.75	1.25
Connected load, upper unit, kw.	1.5	1.5	2.0
Time switch	No	Yes	Yes
Demand (diversified) per customer:			
9 a.m. (industrial peak) kw.	0.67	0.85	0.02
52 a.m. (cooking peak), kw.	0.64	0.73	0.11
1:45 p.m. (cooking and lighting peak), kw.	0.44	0.04	0.08
10 p.m., kw.	0.41	0.82	1.42

Table IV—Electrical Capacity Related to Water Capacity of Heaters

Charging time, hours	Twenty	Ten
Connected load, per gal. of tank capacity:		
Lower unit, watts	25	20
Upper unit, watts	50	30

Table V—Relation of Tank Sizes to Electrical Capacities

Charging Hours — Twenty and Twenty-four. Twin-Unit, "Vertiflow" Tank Water Heater

Tank Size, Gallons	Wattage: Lower Unit	Wattage: Upper Unit	Nominal Capacity, Gallons per Month	Nominal Energy Consumption, Kw.-Hr. per Month
30	750	1,500	1,300	345
50	1,250	2,500	2,150	565
Charging Hours — Ten. Twin-Unit, Plain Type Tank Water Heater				
30	600	1,000	600	165
50	1,000	1,500	1,000	270
66	1,250	2,000	1,350	365
80	1,500	2,000	1,600	435
120	2,500	3,500	2,400	650

*The N.E.L.A. water-heating report ("Electric Water Heating," N.E.L.A. publication No. 166, November, 1931, page 3) states that "The diversity curve was found to be practically level at the 50 heater point. Therefore, it would not be necessary to have complete records for more than 50 heaters to determine the probable diversity within the limits of experimental error for any size group." The report shows some very accurately determined load curves for groups of 60 customers; unfortunately, no time-controlled water heaters were available when the measurements were made.

The only test in the N.E.L.A. report comparable with the here presented test is that for the heaters on the lines of the Alabama Power Company, which were of the twin-unit type, without time switch. Comparing the diversified load curve of the Alabama heaters (page 15, Fig. 34, N.E.L.A. report) with the curves on page 723 of this article shows that the curves are of the same shape; in fact, are in quite close agreement considering that the water heaters used in the two tests are of different construction and connected load, and the average monthly energy consumption differed somewhat.

†See "Electric Water Heating," N.E.L.A. publication, November, 1931, page 3. The Alabama and Maine tests are for approximately comparable conditions, as to energy consumption.

‡For details, see article "Water Heating as an Element of Residential Load," by C. P. Randolph and F. H. McCormick, ELECTRICAL WORLD, May 16, 1931; 24-hour charge is shown as system E and twenty-hour as system F. No test is shown there for the ten-hour system.

There is but little difference in the connected load, tank capacities, etc., theoretically required for the 24-hour and twenty-hour systems; therefore, in the interest of standardization, only the twenty- and ten-hour systems are shown. The twenty-hour connected load can be used for 24-hour service without seriously affecting the 24-hour system load curve. The figures of Table IV, of course, apply only to tank-water heaters of constructions used in these tests; "Vertiflow" for the twenty-hour and "Plain" for the ten-hour as illustrated. The connected loads and corresponding delivery capacities of standard sizes of water heaters designed in accordance with Table IV (but using nearest standard unit wattages) are shown in Table V.

Conclusions

1. Demands per customer on transformer and substation added by the water-heating load are established for three water-heating systems that meet practically all local utility conditions.
2. Water heaters of the twin-unit type may be operated with time switch cutting off the lower unit only, and the upper unit will impose nearly negligible diversified demand during the "off" period.
3. Allowing the upper unit to be thrown on automatically by its thermostat if required during the "off" periods of the lower unit insures satisfactory hot water service.
4. The ratios are stated of connected loads to tank sizes, which will insure maximum gallons of hot water per month per gallon of tank capacity, consistent with (1) load characteristics desired by the utility in order to secure minimum cost to serve, and (2) delivering satisfactory hot water service to the customer.

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Network Unit Used for Radial in Residence Area

By FRANK S. CLARK
Superintendent of Construction
Penn Central Light & Power Company, Altoona, Pa.

Protection of the public in residential areas, elimination of flashover alarms and antagonism of adjacent property owners to unsightly structures were met in a recent installation by installing a network unit even though the service is to be continued on a radial basis. Space and cost requirements were found to be smaller than any other substation design studied and it met the æsthetic objections satisfactorily.

Preliminary estimates indicated that the conventional steel structure with feeder regulators and outdoor transformers would require an undesirable amount of space and offer the hazard of contact with an alarm from flashovers from the open buses. This was discarded along with one involving the installation of the buses in a superstructure on a conventional switch-house. The latter plan contemplated the use of pothead type of transformers, feeder regulators, inclosed buses on primary and secondary and cables for interconnecting leads which would entail a considerable labor item for conduit and splicing.

About this time the General Electric network unit was announced. The cost for the submersible design was not, however, favorable in comparison with the inclosed bus design. A later design of the network unit incorporating the feeders in individual conventional switch-house compartments was more attractive in price and appearance and this was decided upon. The relative costs proved to be as follows, land omitted, estimated values for the first two alternatives and actual costs for the adopted design:

	Steel Structure	Inclosed Bus	Primary Network, Unit
Materials	100	106.8	118.3
Labor	100	114.5	72.8
Total	100	107.0	111.0

This particular network unit has been functioning satisfactorily for four months as a radial feed station with bus regulation rather than with feeder regulation. One minor drawback has been that the tap changers, designed for vault operation, make too much noise for outdoor installation in a residential neighborhood.

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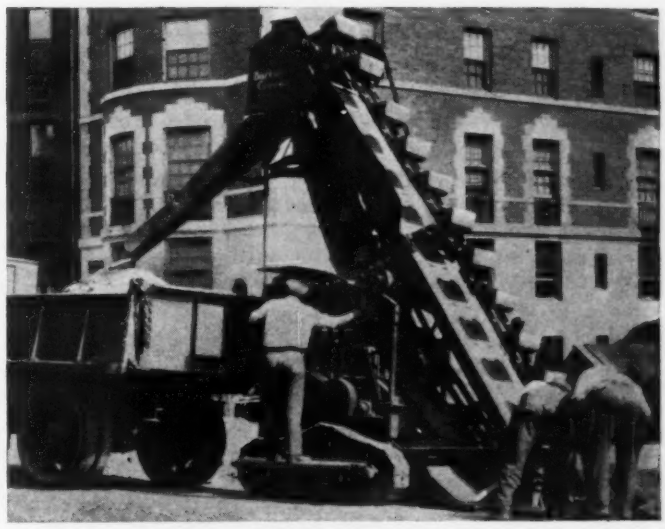
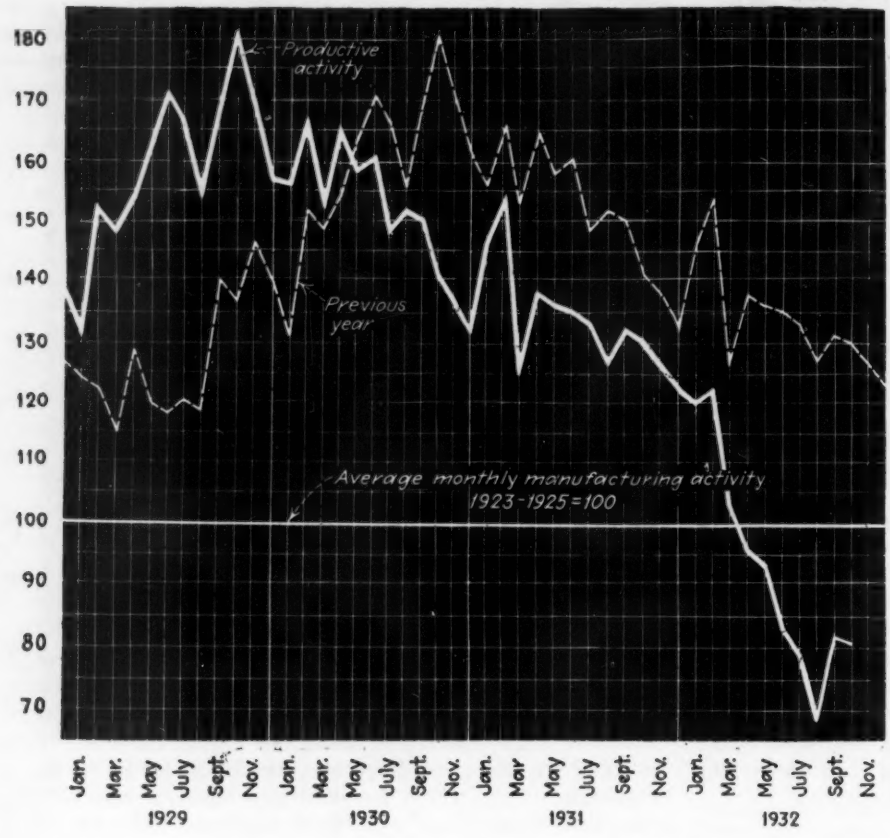
Power Loader Cuts Labor Requirements

The use of a mechanical loader in clearing away earth from the surface of Commonwealth Avenue, Boston, after completing a traffic signal conduit trench reduced the labor requirements to about one-eighth those applying to hand shoveling. The contracting house of F. A. Snow Company, Inc., which handled this construction for the Boston Edison Company, finds that two men can load a 6-cu.yd. truck in ten minutes with the Barber-Greene machine shown, whereas by hand shoveling five men take half an hour for the same work. A truck driver and load distributor are required in each case. The standing time consumed by the truck is also reduced to one-third the former figure. In a high-class residential district such as this section of Boston's Back Bay there is also a public relations advantage in shortening the time the street is disturbed by construction.



Street surface being cleared by mechanical loader after conduit trench is completed

Electrical Manufacturing Holds Gain



Unlike the decrease from September to October in 1930 and 1931, the level of activity in electrical manufacturing in October this year was maintained very close to that of September, according to reports of energy consumption received by ELECTRICAL WORLD for that class of establishments. Adjusted for the difference in the number of working days the index shows a slight decrease, but it amounted to only a fraction of 1 per cent.

Thus the recovery from the low point of August, noted last month, has virtually been sustained. This holds for both large and small plants.

Small establishments in the East as a whole increased their operations over September; in the Middle West there was a net decrease of 3 per cent.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base Average Month, 1923-1925

Month	1929	1930	1931	1932
January	131.3	156.2	146.6	120.0
February	151.8	165.2	154.3	122.2
March	148.3	153.0	126.1	102.9
April	154.6	164.9	138.1	95.6
May	163.5	158.0	136.7	92.8
June	170.5	160.2	135.2	83.1
July	166.6	148.5	133.4	79.2
August	155.4	152.2	126.9	67.6
September	168.8	150.0	132.6	81.4
October	180.6	140.6	130.4	80.9
November	169.5	137.5	126.9	.....
December	157.0	132.4	123.5	.....

▼ ▼ ▼

Industrial Gains and Losses Mixed: South and West

Improvements in some branches, recessions in others, combined to hold the October average of industrial activity in the West at the same level as in September, but lowered that of the South by 4 per cent. Compared with August, however, there have been notable gains in most industries in both of these sections of the country.

In the South a further advance in textiles raised the index, based on energy consumption, fully 50 per cent above the July minimum. This movement was in harmony with the change for the country as a whole, mentioned in last week's issue of ELECTRICAL WORLD. The two groups most closely related to construction activities —iron and steel and the stone, clay and glass industries— have been climbing steadily for several months. Both indices scored an erratic jump in September because of an exceptional increase in a few large plants. This apparently was not maintained in October, but otherwise the improvement continued.

Manufacture of forest products, paper and pulp, and the chemical industries again advanced though the first named remains seriously below the level of former years. Even the metal-working industries, which a year ago were still on the downgrade, have apparently turned and are slowly advancing.

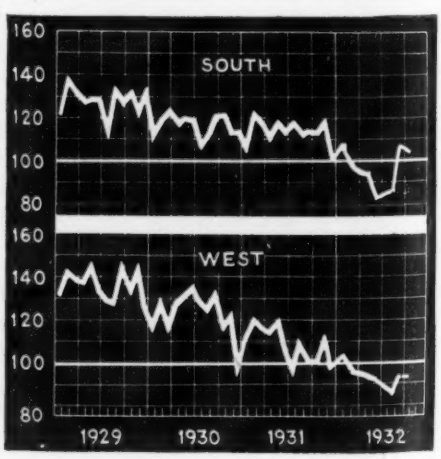
Western paper and pulp, chemicals, foods and the metals group of industries have undergone no important changes though the tendency in the past few months has been slightly upward. Strong gains in forest products balanced recent losses in stone and rubber products and shipbuilding.

Indices of Industrial Activity in South and West

Base: Average Month, 1923-1925 = 100

Industrial Groups	South Oct., 1932	South Sept., 1932	South Aug., 1932	South July, 1932	South Oct., 1931	West Oct., 1932	West Sept., 1932	West Aug., 1932	West July, 1932	West Oct., 1931
All Industry	**103.8**	**108.5**	**87.9**	**85.3**	**113.2**	**96.2**	**96.0**	**89.4**	**88.7**	**102.2**
Chemicals	146.8	144.0	120.8	122.2	144.6	85.2	84.2	85.3	88.7	88.0
Food	151.0	171.6	153.7	157.5	148.8	113.9	120.0	113.6	112.5	131.8
Iron and steel	85.7	107.1	79.0	73.7	160.2	.....	.....	.....	.....	.....
Metal working plants	64.3	61.2*	62.8	61.3	76.6	.....	.....	.....	.....	.....
Metals group	76.2	87.0*	72.0	68.2	122.2	38.2	38.4	35.6	31.7	45.2
Forest products	50.5	44.1	33.7	31.6	55.7	132.8	121.2	104.8	103.8	128.1
Paper and pulp	145.0	142.2	114.1	119.0	133.8	139.5	135.4	126.7	120.0	124.3*
Rubber products	78.6	86.8	88.9	104.5	73.8	75.8	84.5	92.8	103.0	107.4
Shipbuilding	.....	.....	.....	.....	.....	88.5	108.0	96.5	103.3	88.1
Stone, clay and glass	113.8	143.2	103.2	95.7	154.9	69.3	81.3	82.0	79.3	87.3
Textiles	107.8	105.3	81.2	71.2	111.7	.....	.....	.....	.....	.....

*Revision.



Why the Regional Farm Load Deserves Cultivation

By W. T. ACKERMAN
Project Director and Engineer
New England Rural Electrification Program, Durham, N. H.

IN the short period of six years ending in the spring of 1930 the number of New England farms reached by electric service increased from about 10 to 43 per cent. Considerable information on the progress of rural electrification is available from the United States Census of 1930 and National Electric Light Association statistics, and from these data and investigations conducted under the auspices of the New England division of the latter organization it is possible to obtain a good idea of the value of the present and potential regional farm load.

With 53,655 farms electrified (at least in part) in 1930 in New England, we find this section to represent four times the average ratio for the country as a whole. It is estimated that this represents 10,731 miles of rural lines on the basis of five customers per mile and at an average of $1,500 per mile an expenditure by the utilities of $16,096,500 for such circuits. If the authorized return of 16 to 20 per cent on the investment is received the annual income from these lines would be $2,890,000. There can be little doubt that before 1929 the total farm service carried by the utilities of New England was handled at a loss, but recent growth of business in this field indicates that if the point has not yet been reached where the service is profitable, it soon will be.

Investment by agriculture in wiring and lighting fixtures

Available data on the investment required by farms to utilize electric service is limited, but some light is thrown upon the matter by the seven farms of the New Hampshire project. Their average cost of wiring, including lighting fixtures, was $358 and ranged from $215 to $450. The average size was 170 acres, against a New England average of 110 acres, and the individual size ranged from 50 to 330 acres. Little or no relation can be developed between the cost of wiring these places and their acreage. Midwestern data give $350 as the average cost of wiring per farm, excluding special power and heating circuits. On the basis of $300 per farm of 110 acres, the wired farms of New England represent an investment of $16,096,500 for what might be termed minimum or initial wiring. By coincidence it appears that agriculture and the electrical industry have thus matched dollar for dollar in developing rural electric service.

The minimum wiring above referred to would in most cases provide adequate service for lighting, flatirons, washers, refrigerators and sundry small appliances. Small water pumps, milking machines, milk coolers and incubators, if not large, might be included, but in many cases would require extra wiring for proper service. On the seven experimental farms in New Hampshire, of the average total equipment investment, 80 per cent was for appliances and 20 per cent for installation, indicating a ratio of about four times greater investment in equipment than in the wiring and installation. About 41 per cent of the total investment was equipment usable on the lighting circuits.

This indicates that as farms are or become more heavily loaded the average investment by agriculture to utilize electricity may become four or five times that by the utility industry in rural lines.

Cost of farm electric service in New England

In the 1930 Census 45,522 New England farms reported that they paid $2,985,478 to utilities for electric service. On this basis the total farms electrified in this section paid $3,451,300, or an average per farm per year of $68.29. The average cost per kilowatt-hour is not apparent from the census figures. In 1930 the average rate paid by the seven farms on the New Hampshire project was 5.67 cents, with a range of from 3.6 to 8 cents per kilowatt-hour. Many of these rates are not specially designed for rural service, but are the prevailing urban rates of the serving companies. For the purpose of computing the amounts paid by farms for electricity and to indicate the possible type of load now in use a figure of 5 cents per kilowatt-hour has been selected as conservative.

On a 5-cent rate it appears that the 45,522 reporting electrified New England farms used a gross total of 69,026,000 kw.-hr. The average bill of $5.69 per farm per month, on a 5-cent rate, represents 114 kw.-hr. per month, or 1,368 per year.

It is not known what makes up this average farm load, but data from the New Hampshire project help indicate the kind of appliances and services which would reasonably make such an average. It will also indicate what applications can be advocated to increase low loads.

The one fruit farm of the group represented in Table II did not quite reach 140 kw.-hr. per month in 1930. From this tabulation it appears that 114 kw.-hr per month can be accounted for in six or seven well-

Table I—Cost of Farm Service in New England

1930 Census	Dollars per Year Paid to Power Cos.	Number of Farms Reporting	Average per Farm per Month	Average per Farm per Year	Computed Gross Power Companies' Income for All Electrified Farms on Same Basis
Massachusetts.	$1,051,305	13,821	$6.33	$76.00	$1,220,000
N. Hampshire.	306,648	5,014	5.10	61.20	314,200
Maine.....	498,169	10,938	3.80	45.20	588,000
Connecticut...	645,337	7,675	7.00	84.10	762,500
Rhode Island..	153,011	1,671	7.62	91.50	174 800
Vermont.....	331,008	6,403	4.31	51.75	391,800
Average.....	.....	.....	5.69	68.29	.....
Totals.....	$2,985,478	45,522	$34.16	$409.75	$3,451,300

Table II—Representative Small Farm Usages of Energy

Farm House	Average Kw.-Hrs per Year
Lighting house and buildings, including small appliances	360
Washing	30
Ironing	84
	474
Farmstead Operations	
Water pumping, including house	300
Miscellaneous	60
Total lighting and pumping	834
Household refrigeration	395
Dairy Farm	
Milking fifteen cows (3 kw.-hr. per month each)	540
Refrigerating 2½ 40-qt. cans of milk per day at 0.06 kw.-hr. per gal	540
Poultry Farm	
Lighting 1,800 birds (5 kw.-hr. per 100 per month for six months)	540
Incubating 4,100 eggs per year (135 kw.-hr. per 1,000)	540
Brooding 3,740 chicks per year (1.25 kw.-hr. per chick for 42 days)	540

proved operations, although actually it may be split into a dozen or more. Whatever the actual uses, it is believed that a check of farms now electrified to determine whether the above practical and economical uses of electricity are employed will indicate favorable load-building activities.

Rural load-building opportunities in one region

To visualize the possibilities of the total New England farm load, data on seven well-known applications have been computed.

In 1929 New England produced 415,303,967 gal. of milk, of which 308,251,487 gal. was sold as whole milk, cream or butter. Taking the average of data acquired by the University of New Hampshire Experiment Station (which co-operates with the New England rural electrification project) of 1.5 kw.-hr. properly to cool 25 gal. of milk (or 0.06 kw.-hr. per gal.), we find by taking the same percentage of this milk as of farms electrified that the potential annual load from refrigeration on market milk, cream and butter only, 137,671,672 gal., would be 8,380,300 kw.-hr. per year. At 5 cents per kilowatt-hour this would represent $419,015. It is highly probable that much more than this quantity is potentially available for electric refrigeration. In these figures only 33 per cent of the total milk produced in the area has been computed as on utility service lines, whereas 43 per cent of the farms have been electrified.

Likewise the milk consumed by farm families has not been included, and this logically would be refrigerated. Home economics authorities estimate the average farm family as five persons, divided evenly between adults and children. The standard recommended milk consumption is 1 qt. per day per child and 1 pint per adult. An average family of five consuming 50 per cent of the standard recommended would use about 2 qt. per day. The 53,655 electrified farm homes would consume 9,657,900 gal. per year, which would represent a refrigeration cost of $28,973.

With 53,655 farm homes electrified and assuming the average energy consumption for lighting and miscellaneous service to be 360 kw.-hr. per year each, the gross annual expenditure at 5 cents per kilowatt-hour would be $965,790.

Thirty kilowatt-hours per year per farm for washing would mean another $80,480.

Another $225,350 would be added by 84 kw.-hr. per year for ironing.

If all these farms used household refrigeration to the extent of 395 kw.-hr. per year per family, this would mean 21,193,700 kw.-hr., or $1,059,685 yearly.

If these farms all used water pumps consuming 300 kw.-hr. per year each the energy would cost them $804,825 annually.

Milking 43 per cent of the total 708,218 cows in New England with electric milkers, or 305,000 cows on the basis of 3 kw.-hr. per cow per month, represents the use of 10,980,000 kw.-hr. per year, or a central station revenue of $549,000.

In sum, the potential gross load of only seven approved and accepted applications of electricity in the farm home and in dairy farming alone on the 43 per cent of the New England farms now electrified would, if this load were so developed, represent the expenditure of $4,104,145 per year at 5 cents per kilowatt-hour. This figure is in excess of the Census total and the computed gross total, indicating that the farms already wired are not using the equivalent of these seven items. In view of the uses for electricity not included in the above items, the loads that the lines already built are carrying appears to be still under their capacity and to offer to utilities and farmers alike excellent opportunities to increase income and lower costs. These figures also indicate that farm loads have been built to somewhere within self-sustaining proportions, and that the opportunities for increasing the number of applications are largely in the hands of the utilities, farm organizations and educational institutions.

Increasing farm density favors economic service

The fact that the New England territory is composed of small farms as compared with other sections may be an economic asset in considering the cost of reaching and serving them electrically. The 1930 Census indicates a marked decline in the number of farms in each New England state, indicating a trend toward compactness and concentration in agricultural operations, with the abandonment of farms lying in back country and otherwise poor locations. This is of value to agriculture as well as to utilities, since long hauls, poor roads and isolation increase operating costs. This process of slowly bringing in the frontier and turning these distant farms back into woodland is logical and correct, according to economists, and, from the standpoint of rural electrification, will automatically eliminate certain zones that might never be economically reached, but over which controversy might arise.

▼

Meter Indicates Fruit Sweetness

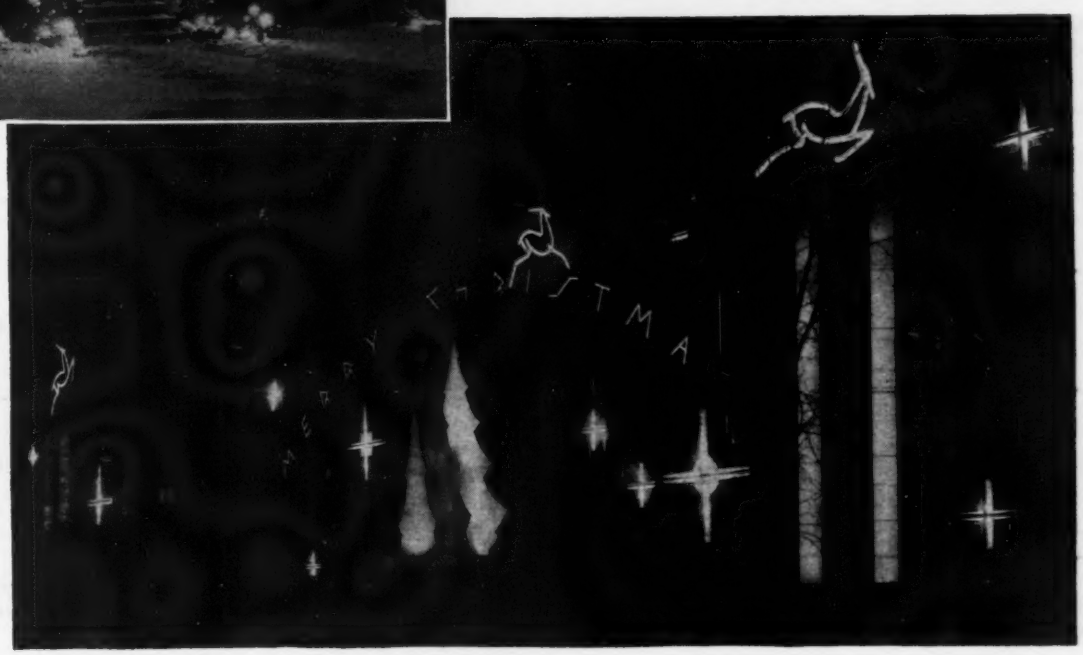
Discovery by R. C. Hitchcock, Westinghouse electronic engineer, that edible substances with an acid content give varying readings when probed with electrodes connected to a milliammeter may offer a new aid to the canning industry and improve the tickling of millions of palates. Already an electryux, or electric palate, a palm-sized instrument, has been devised in order to give comparative readings.

Make It a MERRIE XMAS With Electric Lights

Just three ways in which electric light can be used æsthetically during the Xmas-New Year's season are shown. Parks, streets, monuments, stores, roadside gas and lunch stations and a host of other opportunities exist for the ingenious-minded decorator with light.

From dark to midnight affords 100 hours for festive lighting during those two weeks, but nearly every month there is some occasion for decorative lighting. And besides such lighting stimulates the adoption of more or less permanent forms of æsthetic illumination.

The home and floodlighted building shown would consume 180-kw.-hr. and 700 kw.-hr., respectively, in two weeks, bringing in $9.85 and $22.40 apiece for power alone. If all opportunities were capitalized by utilities, manufacturers, dealers, and contractors, the collective income would be surprising.



To get results, the customer must be shown illustrations of effects that can be produced, where he can get the equipment and who will install it. It is a co-operative job—not for two weeks but throughout the year.

Industrial Plant Load Study Points to Savings

By PERRY A. BORDEN

The Bristol Company, Waterbury, Conn.

A COMPLETE load survey of a light manufacturing establishment having a subsidiary testing plant and laboratory reveals a number of interesting facts regarding value received for the power dollar. The plant manufactures light mechanical and electrical apparatus and machine parts and the object of the investigation was to determine conditions of load, power factor, demand, etc., as affecting the cost of the purchased power, with the possibility of reducing this cost and securing higher efficiency. The principal data were obtained from the charts of graphic wattmeters on the feeders supplying the sections of the load. Supplementary information was gained from the metering equipment on the main circuits. Power factor determinations were made from wattmeter readings, either by interchange of voltage connections or by combination with reactive component readings.

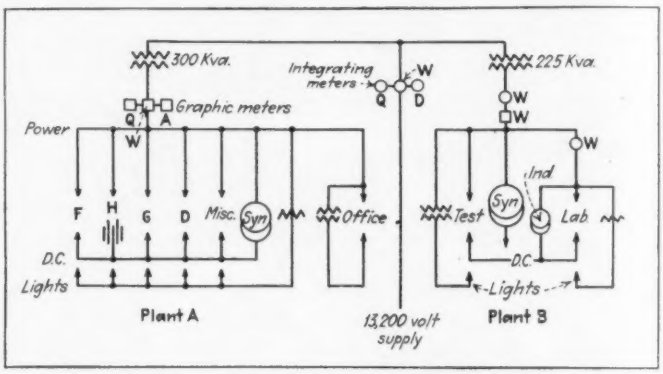
Each element of load studied separately

The power load in the subsidiary plant, known as plant "B," require special consideration. It was made up of a number of small induction motors and motor-generator sets in addition to a relatively large (225-kva.) synchronous motor-generator set used to supply direct current for certain operations having a very irregular schedule. This machine might be running practically full time, or it might stand idle for several weeks. It was designed for operation at a leading current and was originally selected with a view to power-factor correction. Another item of interest in this section of the load was a 30-hp. induction motor-generator supplying a small direct-current load and running continuously throughout the day. In order to show effects on monthly load conditions, this set and the synchronous unit have been given independent treatment in the tabulations.

A small (60-kva.) synchronous motor-generator in the factory switchboard room, supplying direct current for battery charging, photographic work and other light uses, was generally operated at a leading power factor of approximately 22 per cent throughout the day, and in the analytical study a number of assumed operating schedules were considered with a view to finding their effect upon the load characteristics.

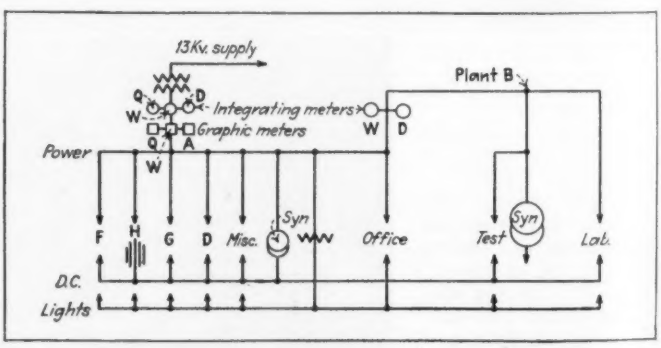
Transformer losses investigated

The total installed transformer capacity was 525 kva. on the primary (13,200-volt) lines and 90 kva. for lighting circuits on the secondary (220-volt) bus. No-load conditions of these transformers were determined from readings made upon the integrating meters used for billing purposes. In order better to understand the effect of the transformer losses on the load characteristics an assumption was made that instead of operating these units for the full 720 hours of the month it would be possible to cut them off when the factory was not running and reduce their operating time to 235 hours per month. A study was also made of the effect of metering the load for billing purposes on the secondary side of the main power transformers, as provided for in the contract. Consideration was given to the effect of reducing the installed motor capacity of the plant and to using capacitors with a view to improving power factor conditions; the outcome of these several studies appears in the tabulations.



Original arrangement of electrical circuits

The main buses are 230 volts, three phase. Lighting is from additional transformers, making up neutrals for several three-wire systems. Metering of the total load for billing purposes is accomplished by a watt-hour meter and a reactive volt-ampere-hour meter on the main supply cable before it divides. Associated with the watt-hour meter is a demand meter giving the fifteen-minute demand of the load. The factory load is metered for record purposes through a set of graphic instruments.



Recommended arrangement of electrical circuits

The whole power load is supplied from one set of transformers and the lighting load from one set of auto-transformers. The general d.c. load is transferred to the small synchronous machine. Metering of the load for billing purposes is performed on the secondary side of the power transformers and the factory graphics are connected to measure the billing load. The load of subsidiary plant "B" is metered through a watt-hour meter and a demand meter.

No allowance was provided in the power contract for the possibility of the average power factor having a leading value, and the reactive volt-ampere-hour meter being fitted with a ratchet to prevent backward rotation, any magnetizing current which might be returned to the supply system was not recognized.

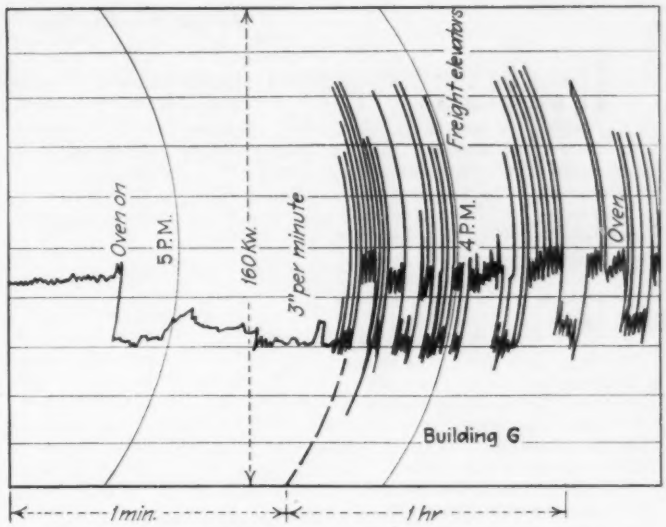
New load combinations also studied

Load values derived for the most part from Table I are combined in various ways in Table II to stimulate real or hypothetical operating conditions. Applying to these the rate schedule in the contract, there has been obtained a series of values representing the costs for power taken under the respective conditions.

The "average kilowatt" column in Table II represents either the demand or the mean of the load unit under consideration. Monthly consumptions were obtained from the average loads multiplied by the operating hours per month, due allowance being made for those units which operated on an irregular schedule. From the integrated consumption values were obtained for the respective average power factors. As the load was considered as being metered on the primary side of the power transformers 5 per cent was deducted from each kilowatt-hour value before embodying it in the computation of energy charge, which was calculated in accordance with the sliding scale in the contract.

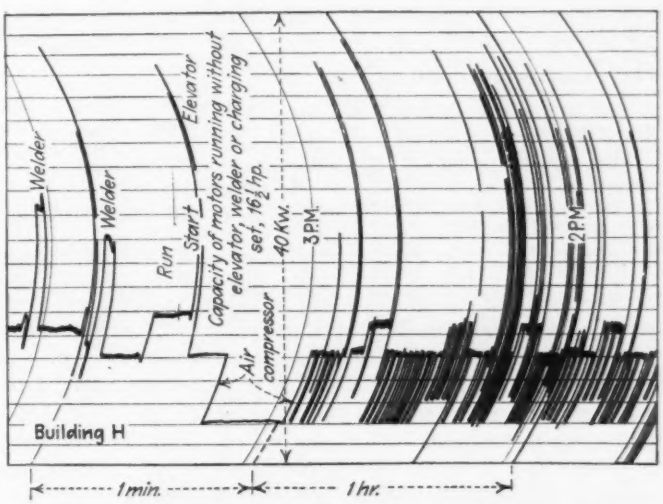
The "billing demand" is based upon the measured demand, or, for purposes of computation, sometimes on the average kilowatts. In instances where the average power factor swung outside the working zone of from 70 to 85 per cent lagging values of billing demand were adjusted up or down according to the terms of the contract. Demand charges were computed from the sliding scale in the contract. In view of the customer being considered in the contract as supplying and maintaining the high-tension equipment, although actually owned by the power company, there is allowed from the total bill a "demand deduction" based on the measured demand. The sum of the energy charges and the demand charges, less this deduction, furnish the basis of the total cost of the load to the customer. The equivalent prices per kilowatt-hour, appearing in the last column, furnish a convenient basis of comparison of different conditions.

The principal element of the load in plant "B" was the large synchronous unit, and from the tables it will



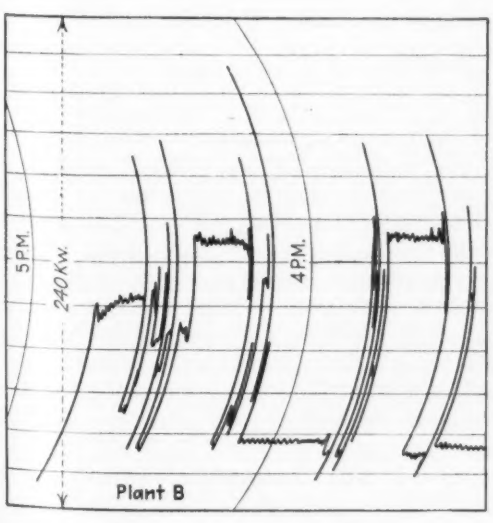
General machine shops

The extreme fluctuations are due to freight elevators having a heavy starting load. Detailed measurements showed that this characteristic did not have an appreciable effect on the total energy consumption or on the billing demand. The secondary fluctuations are due to an enameling oven under automatic control.



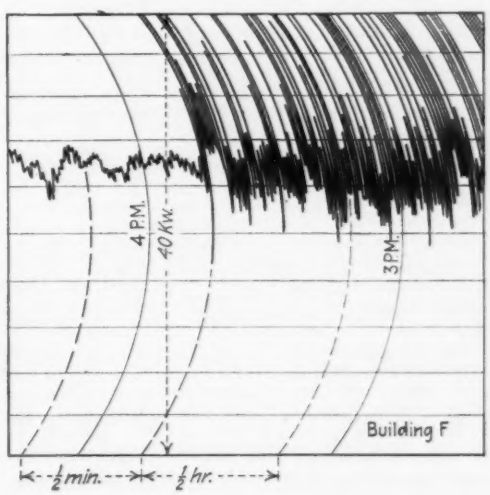
Small machine shop with welders and compressor

The regular 6-kw. swing of the compressor as the automatic unloader operates is very noticeable. The effects of the elevator and the welders are easily segregated.



Laboratory and testing

The principal element of this load is a large motor-generator set. This machine might operate but a few hours per month, giving this section of the load a very poor load factor, but materially increasing the total demand.



Punch presses, automatic lathes and woodworking machinery

Effect of elevator very noticeable

Table I—Elements of Load Combinations

Unit No.	Load Condition	Connected Load—Total	Connected Load—During Test	Average Load Values—Kw.	Average Load Values—R.-Kva.	Average Load Values—P.F., %	Max. Demand—Observed	Max. Demand—Estimated	Operating Hours per Month	Consumption per Month—Kw.-Hr.	Consumption per Month—R.-Kva.-Hr.
1	Building "D" normal	50	375	13.6	17.2	62	24	38	225	3,060	3,870
2	Building "F" normal	190	100	28	41.3	55	30	50	225	6,300	9,300
3	Building "H" compressor off	65	10	6.4	7.6	64	...	...	80	511	608
4	Building "H" compressor on	65	15	12.8	8.3	84	20	...	145	1,860	1,205
5	Building "H" charging set only	65	15	8.4	6.3	81	...	...	40	336	252
6	Building "H" computed average	65	...	12	9.2	80	...	25	225	2,707	2,065
7	Building "G" normal	225	108	62.5	65	70	70	...	225	14,100	14,600
8	Building "G" elevator alone	...	22	8	16	18	...	...	73	219	1,168
9	Building "G" normal + elevator	...	130	63.7	70	64	...	...	225	14,319	15,718
10	Building "G" oven alone	...	24	24	0	100	...	...	114	2,736	000
11	Building "G" computed average	225	...	76	70	73.5	...	80	225	17,055	15,768
12	Plant "B" without m.-g. sets	...	22	11.5	18	54	...	...	...	2,548	3,895
13	Plant "B" ind. m.-g. set, alone	...	28	3.2	13	24	...	...	235	752	3,055
14	Plant "B" computed average	85	50	14.7	30.9	43	...	...	225	3,300	6,950
15	Miscellaneous load	55	...	15	15	71	...	25	225	3,375	3,375
16	Lighting load	...	50	50	0	100	50	75	0—28	1,400	000
17	Total transformer load	...	...	6.1	18.4	32	...	...	720	4,400	13,230
18	Reduced transformer oper. time	...	...	6.1	18.4	32	...	...	235	1,433	4,330
19	Surplus motor capacity	...	...	10	50	00	...	...	225	000	11,250
20	Mean load of factory	865	440	202	188	78.5	190	...	...	45,950	36,700
21	Base load (= mean load + trans.)	871	446	208	206	71	...	208	...	50,350	49,930
22	Small syn. m.-g. set, loaded	48	...	15	—50	28 lead	...	...	75	1,125	—3,750
23	Small syn. m.-g. set, no load	48	...	10	—41	23 lead	...	...	150	1,500	—6,150
24	Small syn. m.-g. set, no load	48	...	10	—41	23 lead	...	...	495	4,950	—20,300
25	Large syn. m.-g. set in Plant "B" loaded	225	...	70	0	100	...	...	5	350	000
26	Large syn. m.-g. set in Plant "B" loaded	225	...	70	0	100	...	...	50	3,500	000
27	Large syn. m.-g. set in Plant "B" loaded	225	...	70	—203	40 lead	...	...	5	350	—1,015
28	Large syn. m.-g. set in Plant "B" loaded	225	...	70	—203	40 lead	...	...	50	3,500	—10,150
29	Large syn. m.-g. set in Plant "B" light	225	...	22	—213	10 lead	...	...	235	5,170	—50,055
30	Large syn. m.-g. set in Plant "B" light	225	...	22	—213	10 lead	...	...	720	15,840	—153,360
31	Large syn. m.-g. set in Plant "B" light	225	...	22	—213	10 lead	...	...	138½	3,045	—19,100
32	Capacitors to give 100% avg. P.F.	...	...	00	—60	0 lead	...	...	720	000	—43,200

The first eleven units in the table may be said to represent the manufacturing units in the plant; and they include lathes, presses of various types, screw machines, woodworking machinery, grinding, punching and cutting machinery, blowers and freight elevators. Particular attention has been given to an air compressor and a battery charging set in Building "H," besides an oven and a heavy elevator in Building "G." The "Miscellaneous" load was made up of various small units of power in different parts of the plant, which could not conveniently be grouped for metering purposes. Data on this load are based on a careful estimate of duty cycles of the component parts. Information as to the lighting load was obtained by actual test; and in the tabulations allowance is made for seasonal variations of this component.

be seen that its operation with load adds from $113 to $150 to the monthly bill of the factory. The system of redistributing the cost of this part of the load was to charge plant "B" on a basis of monthly kilowatt-hour consumption at the unit rate for the month. This was found to approximate $30 per month, leaving a balance of from $80 to well over $100 to be borne by the company. The power supply scheme shown in the lower illustration on page 730 was recommended to obviate some of these inconsistencies.

In recognition of the metering being performed on the high-tension side of the main transformers, a 5 per cent deduction from the energy consumption was allowed before incorporating the kilowatt-hour values in the computation. With a view to studying the economic significance of this arrangement, there is shown the following calculation, based on the actual billing load of a typical month:

	Primary Metering	Secondary Metering
Kilowatt-hours	54,000	50,665
Energy for billing	51,300	50,665
Reactive-kva. hours	46,440	35,840
Average power factor, per cent	76.1	81.5
Maximum demand (kw.)	362.88	354.38
Billing demand	362.88	354.38
Energy charge	$698.25	$691.90
Demand charge	$597.10	$586.30
Demand deduction	$38.14	$37.73
Total bill for power	$1,257.21	$1,240.47

If, therefore, the above load had been metered on the secondaary side of the transformers instead of the primary the saving to the customer would have been $16.74 for the month under consideration. It will be noted that the two values of power factor both lay within the working zone of the contract, but if the average power factor as determined by primary measurement had been slightly below either limit of this zone it is probable that secondary metering would have carried it to a value where there would have resulted a decrease in the billing demand and a corresponding reduction of the total charge. For the same reason any action tending to improve the average power factor of the load would make its beneficial effect evident sooner with secondary metering than with primary metering.

Reduction of fixed charges

In the original arrangement the high-tension equipment through which power was supplied was the property of the utility, the customer paying interest thereon at the rate of 15 per cent per annum, which on the investment amounted to $92.92 per month. In recognition of this payment the customer was considered in the contract as "supplying and maintaining" the equipment and was granted a reduction on the demand charge, which under average conditions approximated $35 per month. (See column "demand deduction," Table II.) If the customer were to acquire this apparatus he would be relieved of the interest charge as billed against him by the utility, but of course he would have to carry the fixed charges on his own investment, which would approximate $37.20 per month, plus a more or less indefi-

nite but probably negligible sum representing the time of his regularly employed electrical staff servicing the equipment. The customer would still be entitled to the demand deduction. If, on the other hand, the customer were to relinquish possession of the high-tension equipment he would be relieved of the interest charges, but would no longer be entitled to the demand deduction. The three possible arrangements are compared below:

Arrangement	Interest Paid	Deduction Received, Average	Net Cost
(A) Utility owns high-tension equipment Company pays rental for same.....	$92.92	$33.50	$59.42
(B) Company acquires high-tension equipment	37.20	33.50	3.80
(C) Utility retains high-tension apparatus.....	.....	.....	.....

From the above it is seen that with the customer acquiring the equipment as in scheme (B) the cost would be reduced from that of the original arrangement, as in scheme (A), by the difference between 15 per cent per annum and the cost to the customer of carrying the same investment. If, on the other hand, the apparatus under consideration is treated as the exclusive property of the utility, both the interest charges and the demand deduction are eliminated, which, from a purely monetary standpoint, appears to be the best arrangement of the three.

Summary and recommendations

1. Reduction of installed motor capacity would not bring about any material reduction in power charges.
2. The small induction motor-generator set in the subsidiary plant should be dispensed with and d.c. load transferred to the synchronous set in the main plant.
3. If found practicable, from a mechanical and operating standpoint, reduction of the operating hours of the main power transformers might be made to bring about a saving of from $30 to $40 per month.
4. No practicable operating arrangement of either synchronous set for power-factor correction only could bring about any reduction in the total power bill.
5. The synchronous sets, when operated, should be run at power-factor values as far as possible to the lead.
6. In the distributing of power charges against the subsidiary plant the element of demand should be taken into account in the computation.
7. The use of suitable capacitors might effect a monthly saving of $20 over the carrying charges.
8. By transferring the metering equipment to the secondary side of the main power transformers and adjusting the charges accordingly, in agreement with the contract, a saving approximating $16 per month would result.
9. The customer's main graphic metering equipment should be electrically located at the same point as the utility's meters for

Table II—Various Possible Load Combinations and Corresponding Unit Costs

Comb. No.	Description of Load Combination	Average Kw.	Monthly Consumption Kw.-Hr.	Monthly Consumption R.-Kva.-Hr.	Average Power Factor	Kw.-Hr., 5 per Cent Deduction	Energy Charge	Billing Demand	Demand Charge	Demand Deduction	Net Charge for Power	Equivalent Kw.-Hr. Rate
1	Composite load of factory (computed).....	162	36,922	27,478	80 lag	35,100	$499.25	162	$298.00	$24.30	$772.95	$0.0210
2	Factory load, from switchboard graphics.....	150	33,750	22,500	84 lag	32,100	457.75	150	278.50	22.50	713.75	0.0212
3	Mean load of factory.....	202	45,950	36,700	78.5 lag	43,652	606.75	202	361.60	30.10	938.25	0.0204
4	Base load (= mean load + trans. losses).....	208	50,350	49,930	71 lag	47,800	657.25	208	371.50	30.40	998.35	0.0195
5	Base load less small syn. m.-g. set.....	193	47,725	59,830	62.5 lag	45,300	630.25	214	380.90	28.95	982.20	0.0203
6	Base load with small set running continuously.....	208	55,300	29,630	88 lag	52,550	710.75	201	360.00	30.40	1,040.35	0.0188
7	Base load less small ind. m.-g. set in Plant "B".....	204.8	49,598	46,875	71.5 lag	47,150	649.45	204.8	366.25	30.24	985.46	0.0199
8	Base load with reduced motor capacity.....	204.8	49,598	35,625	81.5 lag	47,150	649.45	204.8	366.25	30.24	985.46	0.0199
9	Base load with reduced trans. time.....	204.8	47,383	41,030	76 lag	45,014	623.25	204.8	366.25	30.24	959.26	0.0203
10	Base load with reduced motor capy. and trans. time	204.8	47,383	29,780	85 lag	45,014	623.25	204.8	366.25	30.24	959.26	0.0203
11	Base load with large syn. set loaded, 100% PF., 5 hrs	278	50,700	49,930	71 lag	48,150	662.25	278	483.50	33.90	1,111.85	0.0219
12	Base load with large syn. set loaded, 100% PF., 50 hrs	278	53,850	49,930	73 lag	51,150	696.75	278	483.50	33.90	1,146.35	0.0213
13	Base load with large syn. set loaded, 40% lead, 5 hrs	278	50,700	48,915	72 lag	48,150	662.25	278	483.50	33.90	1,111.85	0.0219
14	Base load with large syn. set loaded, 40% lead, 50 hrs	278	53,850	39,780	81 lag	51,150	696.75	278	483.50	33.90	1,146.35	0.0213
15	Base load with large syn. set light, 10% lead, 235 hrs	230	55,520	125	100	52,800	713.25	185.5	351.40	31.50	1,033.15	0.0185
16	Base load with large syn. set light, 10% lead, 720 hrs	230	66,190	—103,430	54 lead	62,900	814.25	134	252.80	31.50	1,035.55	0.0157
17	Base load at 100% PF., with capacitor.....	208	50,350	000	100	47,800	675.25	177	322.00	30.40	966.85	0.0192

Combinations 1 and 2 show the factory load, as built up from the component units in Table I and as derived from the graphic meter charts, respectively. The mean load of the factory, as shown in combination 3, represents the composite of the factory load and the weighted average of the lighting load throughout the year. This mean load, with transformer losses added, as shown in combination 4, constitutes the load which was made the basis of the principal calculation of power costs. The monthly cost of this typical load is computed to be $998.35. The mean of the power bills actually rendered for the twelve months immediately preceding the load survey was $1,034.59. Thus the computed average bill comes within 3½ per cent of the true average for the year.

With a view to determining the effect of the small synchronous set, two computations are given, one with the set shut down entirely (combination 5) and one with the set running continuously throughout the day at no load, 23 per cent leading power factor (combination 6). It will be seen that the elimination of the set effects a saving of $16.15 per month, while its continuous running at a leading power factor would improve the average monthly power factor of the plant sufficiently to bring about a reduction of the demand charge, but not sufficient to offset the increased energy charge, so that the total bill would be increased by $42. Thus, there could be no condition where this machine could be economically operated purely for purposes of power factor improvement.

The small induction motor-generator set in Plant "B," however, carrying a negligible d.c. load, could be shut down, as shown in combination 7, with a resultant reduction in the total charge of $12.89, but this reduction is not due to any improvement in power factor.

A hypothetical reduction of motor capacity to approximately half its normal value (combination 8), while improving the power factor, did not thereby reduce the charges. An assumed reduction of the operating hours of the main transformers to the working hours of the day, plus noon periods (combination 9), brought about a reduction in the energy charges to the extent of $38.09, but the reduced motor capacity, applied in conjunction with this (combination 10), brings about no further reduction.

A series of assumed operating schedules on the large set in Plant "B," shown in combinations 11 to 16, inclusive, shows that there is no condition where this element of the load could combine with the balance of the load to reduce the total charges. Even combination 16, which assumes that the reactive volt-ampere hour meter could rotate backward so as to allow for leading power factor, and that the contract provided a bonus for reactive current returned to the system, giving a mean power factor of 54 per cent leading, for the month, builds up an energy charge which more than offsets the saving that would be effected.

Combination 17 is a study of a capacitor of such size as to give a mean monthly power factor of 100 per cent (again assuming no ratchet in the reactive meter) and here appears a reduction in the total bill amounting to $31.50 per month. Allowing a carrying charge of $10 per month on a suitable capacitor installation, this represents a saving of $21.50 on the monthly bill.

billing, thus furnishing a continual check on demand, power factor and general load conditions.

10. By allowing the high-tension and transforming equipment to revert to the utility and applying the provisions of the contract the customer would be saved a sum of approximately $50 per month.

11. The ratchet which prevents backward rotation of the reactive volt-ampere-hour meter should either be removed or have its presence recognized in the definition of "average power factor" in the contract.

12. As a check on production, as well as on power conditions, the loads of the several departments and sections of the plant should be kept under continual observation by recording instruments, either permanently or temporarily connected into the feeder circuits.

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Restoring "High Line" Service Quickly After Storms

By GUY F. HARDEN

To restore service at top speed on transmission lines with pole sections downed by storms and minor tornadoes a Western power company adopted the following method employing double-drive bars and stranded cable:

After killing the circuits and chaining wires on both sides on standing poles two turns were taken with stranded cable around the down pole or poles under the 2,200-volt circuits, fastening with two three-bolt guy clamps. Two heavy hexagonal steel drive bars were then driven into earth at a proper angle. The two bars were connected by a log chain made up with a round ring to allow sliding up and down the first bar before driving. The other end of the chain had a large ring to slip it over the head of the second bar. Mushroom heads were made on each bar by heating. In raising poles tackle was hooked into the loop of the stranded cable at the pole, the other end of the tackle being at the first drive bar. Hauling away then followed by motor truck, raising the pole.

Slack was then taken in, making a turn around the first drive rod, and making fast with two three-bolt clamps. The tackle was then eased off and an extra heavy pike placed on the under side of the pole, the latter being off the ground at an angle of 45 deg. The line was then unchained and put back in service. An experienced crew can handle this set-up quickly and service can be maintained for a considerable period, sometimes a week, until the line can be killed for permanent repairs. The second drive bar is the key to the situation and both bars can be pulled up and used repeatedly. Ten sets of bars and cable were made up and proved to be worth their weight in gold to the operating company, as they never pulled out under the heavy strain put upon them. In case all poles should be down it would be necessary to start raising with a gin pole, and if many poles are down it may be necessary to raise each pole part way, belay slack and go up and down the line twice to bring them up without excessive strain. This method has saved many hours.

Costs of Municipal Street Lighting in

	1,000-Cp.—20-Amp. Lamps.			600-Cp.—20-Amp. Lamps			400-Cp.—6.6-Amp. Lamps		250-Cp. 6.6-Amp. Lamps
	Aerial System	Underground System	Total	Aerial System	Underground System	Total	Aerial System	Underground System	Underground System
Average number of lamps	5,977	1,240	7,217	22,380	3,060	25,440	183	885	28,348
Operation and Maintenance:									
Electrical energy	$110,288.16	$22,880.60	$133,168.76	$247,854.62	$33,888.94	$281,743.56	$1,507.12	$7,288.65	$153,894.55
Substation expense	26,712.12	5,163.01	31,875.13	80,702.49	11,936.73	92,639.22	143.53	1,901.74	57,108.13
Labor — renewals, cleaning and patrolling	22,382.05	4,643.42	27,025.47	83,806.19	11,458.76	95,264.95	685.29	3,314.09	106,108.60
Incandescent lamps	11,544.60	2,395.08	13,939.68	34,422.33	4,706.54	39,128.87	259.02	1,252.66	36,137.42
Lamp fixture repairs and renewals	5,115.10	1,061.19	6,176.29	21,187.08	2,896.90	24,083.98	123.71	598.25	7,244.73
Lamp globes, signal glass, etc	1,440.72	298.89	1,739.61	210.03	28.72	238.75	61.76	298.65	61,966.81
600-volt lead-covered cable in conduit	.....	5,271.78	5,271.78	.....	.....	.....	.....	.....	.....
600-volt jute-covered cable	.....	.....	.....	.....	.....	.....	.....	3,213.21	68,696.65
Duplex lead-covered cable	.....	340.11	340.11	.....	4.50	4.50	.....	.....	.....
5,000-volt armored parkway cable	.....	.....	.....	.....	.....	.....	25.63	.....	820.61
5,000-volt S. C. lead-covered cable	.....	765.00	765.00	.....	1,887.82	1,887.82	.....	545.99	17,488.85
Transformer maintenance	8,387.20	1,740.02	10,127.22	.....	140.32	140.32	256.79	1,241.87	39,779.20
Conduit system	7,145.22	1,381.05	8,526.27	21,587.08	3,192.95	24,780.03	38.39	508.70	15,275.83
Lamp-post maintenance, underground system	.....	377.49	377.49	.....	1,834.94	1,834.94	.....	638.22	21,785.02
Aerial maintenance	30,273.38	.....	30,273.38	113,354.25	.....	113,354.25	.....	.....	.....
City-owned automobile expense	10,729.79	2,225.75	12,955.54	28,982.27	3,458.75	32,441.02	149.03	999.66	28,174.12
Administrative overhead expense	17,997.53	3,733.34	21,730.87	48,613.20	5,801.51	54,414.71	249.95	1,676.77	47,257.66
Total	$252,015.87	$52,276.73	$304,292.60	$680,719.54	$81,237.38	$761,956.92	$3,500.22	$23,478.46	$661,738.12
Cost per lamp	$42.16	$42.15	$42.16	$30.41	$26.54	$29.95	$19.12	$26.52	$23.34
Estimated Additional Charges:									
Ground rent	20.12	4.17	24.49	54.34	6.49	60.83	0.27	1.87	52.83
Office rent	555.15	115.16	670.31	1,499.52	178.96	1,678.48	7.71	51.72	1,457.71
Taxes	30,122.54	13,569.04	43,691.58	74,148.61	22,489.85	96,638.46	426.98	2,353.98	68,787.63
Depreciation	93,617.76	42,171.19	135,788.95	230,446.25	69,896.15	300,342.40	1,327.00	7,315.94	213,784.88
Interest	48,604.34	21,894.38	70,498.72	119,642.75	36,288.58	155,931.33	688.95	3,798.27	110,992.53
Legal and other services	166.55	34.55	201.10	449.86	53.68	503.54	2.31	15.52	437.31
Total	$173,086.46	$77,788.49	$250,874.95	$426,241.33	$128,913.71	$555,155.04	$2,453.22	$13,537.30	$395,512.89
Charges per lamp	$28.95	$62.73	$34.76	$19.04	$42.12	$21.82	$13.41	$15.29	$13.95
Complete cost per lamp	$71.11	$104.88	$76.92	$49.45	$68.66	$51.77	$32.53	$41.81	$37.29

* From 35th annual report, Department of Gas and Electricity, city of Chicago.

Residence Cooling With Fans

By S. S. SANFORD*
Detroit Edison Company, Detroit, Mich.

Comfort cooling in the home with electricity or ice is still a luxury because of its cost, and it is probable that until the cost is considerably lowered comfort-cooling equipment will in general be installed only in the homes of the well-to-do. There are, however, thousands of home owners who can afford to pay a moderate amount for relief from the heat in summer. In most homes indoor temperature does not become serious until late afternoon and it is at dinner time and in the evening that cooling is needed most. In general, on hot days in Detroit the temperature begins to drop before sundown and there is a considerable drop during the evenings. If, then, outdoor air can be introduced into the house in sufficient volume during the evening a very appreciable degree of comfort can be obtained. With this in mind, the Detroit Edison Company made two installations of fans in homes this summer. In one home a multi-blade fan driven by a ½-hp. motor was installed in the attic. Openings covered by grilles were made in the ceilings of the second floor bedrooms and these openings connected by ducts to the fan. Air is discharged out-of-doors through openings in the attic. The house can be cooled by opening windows and operating the fan whenever the outdoor temperature is lower than the indoor temperature. The degree of cooling in different rooms can be regulated by the manipulation of windows; for example, the first floor can be cooled by opening first-floor windows and closing the bedroom windows. This method of cooling has been very successful. On one occasion the second-floor temperature was lowered ten degrees in three hours. In addition to a lowering of temperature, comfort is obtained by the movement of air. The cost of the installation was $260.

In another home a propeller-type fan driven by a ⅙-hp. motor was installed at the top of the attic stairs. It was arranged so that air pulled up from the first and second floors was discharged into the attic and thence out of doors through openings in the attic. Cooling in various rooms is regulated by the manipulation of windows. When cooling the bedrooms it is of course necessary that bedroom doors be kept open. This installation has also worked out successfully. Its cost was $152.75.

*Excerpt from paper to Great Lakes Power Club.

in hicago in 1931*

Cp. Amp. nps der- und tem	100-Cp. 6-6-Amp. Lamps Underground System	100-Cp. 4-Amp. Lamps Underground System	Total Street Lights	Through Street Stop Signs	Traffic Signals	Total
348	19,719	7,122	88,914	629	Loop—272 Outlying 1,489	
394.55	$45,938.66	$16,794.82	$640,336.12	$974.65	$43,048.22	$684,358.99
108.13	24,188.42	10,138.65	217,994.82	1,475.14	207.32	219,677.28
108.60	63,293.65	22,860.06	318,552.11	8,274.23	23,165.21	349,991.55
137.42	18,902.54	5,604.03	115,224.22	468.58	3,875.78	119,568.58
244.73	12,267.96	5,326.20	55,821.12	3,005.56	12,714.24	71,540.92
966.81	34,723.24	16,048.24	115,077.46	219.26	1,163.09	116,459.81
.....	.....	.....	5,271.78	.....	4,242.94	9,514.72
596.65	38,523.72	.....	110,433.58	.....	.....	110,433.58
.....	.....	.....	344.61	413.80	15.53	773.94
820.61	570.80	9,919.32	11,336.36	.....	.....	11,336.36
488.85	12,165.32	.....	32,852.98	.....	.....	32,852.98
779.20	27,670.61	.....	79,216.01	.....	17,628.55	96,844.56
275.83	6,470.15	2,711.98	58,311.35	394.59	55.45	58,761.39
785.02	24,952.55	20,971.02	70,559.24	3,238.99	952.21	74,750.44
.....	.....	.....	143,627.63	.....	.....	143,627.63
174.12	14,880.62	5,303.92	94,903.91	1,734.45	4,297.82	100,936.18
257.66	24,959.90	8,896.50	159,186.36	2,909.19	7,209.02	169,304.57
738.12	$349,508.14	$124,575.14	$2,229,049.66	$23,108.44	$118,575.38	$2,370,733.48
23.34	$17.72	$17.49	.....	$36.73	$67.33	.....
52.83	27.90	9.96	177.95	3.25	.....	181.20
457.71	760.91	274.42	4,910.26	89.74	.....	5,000.00
787.63	48,769.16	16,617.15	277,284.94	1,232.79	.....	278,517.73
784.88	151,569.56	51,644.40	861,773.13	3,831.35	.....	865,604.48
992.53	78,691.66	26,812.67	447,414.13	1,989.15	.....	449,403.28
437.31	230.97	82.33	1,473.08	26.92	.....	1,500.00
512.89	$280,059.16	$95,440.93	$1,593,033.49	$7,173.20	.....	$1,600,206.69
$13.95	$14.20	$13.40	.....	$11.40	.....	.....
$37.29	$31.92	$30.89	.....	$47.13	$67.33	.....

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READERS' FORUM

Prefers Kva. to Kw. Demand Billing

To the Editor of the ELECTRICAL WORLD:

I have read with a great deal of interest Dean Taylor's article "Retaining Existing Customers" (ELECTRICAL WORLD, October 22, 1932, pages 565-568) and I wish to supplement a small portion of that article with reference to improved rates. Mr. Taylor mentions power-factor improvement in another part of his article, but does not make mention of it in discussing rates.

Since all power customers tax an electric system on the basis of kva.-demand and kva.-hours, therefore a fair and equitable rate should be based on these factors. The kw.-demand and kilowatt-hour energy charges should be discarded and the true measure of the service rendered should be used as a rate base. The electrical equipment from the generator to the consumer's meter depends on the kva.-demand. The prime mover is the only part of the whole system in which a difference is felt when the same kva.-demand continues and there is a change in power-factor. The prime mover represents only a small portion of the investment necessary to serve the average power customer.

The question of properly metering a customer on the basis of kva.-demand and kva.-hours was a problem a few years ago, but that problem has been solved and is now simply a question of the operating companies telling the manufacturers what they need to meter their power customers.

And last, but not least, the power customer will understand the electrical capacity necessary to operate his plant and will not be laboring under the delusion that all he needs is the kw.-demand capacity when he contemplates an isolated plant. The price per kva.-hour could be scaled down slightly from the present kilowatt-hour rates and produce, on an average, more income for the operating company and at the same time show a lower price per unit on consumer's bill.

WALTER C. HERBERT.

Orangeburg, S. C.

Men of the Industry

E. W. Marchant New President of British Institution

Edgar W. Marchant, who recently took office as president of the Institution of Electrical Engineers (Great Britain), is well known in the electrical industry in England as an engineer and educator. Since 1903 Dr. Marchant has held the chair of electrical engineering at the University of Liverpool, and in addition to his academic duties he has held office in several technical societies during this period of time, among them being the presidency of the Liverpool Engineering Society.

After obtaining his technical education, he spent some time with a manufacturing company and then acted as director for three years of the private laboratory and works of Lord Blythswood near Glasgow. It was in 1901 that he became lecturer in electrotechnics at University College, Liverpool. Dr. Marchant has presented scientific papers before the Royal Society and the Institution of Electrical Engineers and has contributed articles to the *Philosophical Magazine* and other electrical publications.

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PROF. ROBERT E. DOHERTY of the electrical engineering department has been appointed dean of the new school of engineering at Yale University, which is a reorganization of the division of engineering in the Sheffield Scientific School and in the Yale Graduate School. Professor Doherty joined the Yale faculty in 1931 after about 22 years' engineering service with the General Electric Company.

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J. S. BROWN, who was formerly engineer in the electrical division of the Stone & Webster Corporation, Boston, Mass., and still earlier identified with engineering projects of McClellan & Junkersfeld, Inc., and also those of Dwight P. Robinson Company, New York, as electrical engineer, assistant superintendent of construction in charge of field forces and electrical construction superintendent, has tentatively entered upon a consulting engineering practice of his own in electrical and industrial fields at Petersburg, Va.

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W. F. CLARK, formerly vice-president and sales manager of the Automatic Electric Heater Company, Pottstown, Pa., manufacturer of Sepco electric water heaters, and his son, G. H. CLARK, engineer, have become associated with the Hoffman Gas & Electric Heater Company, Louisville, Ky., specializing in the manufacture of both gas and electric water heaters. W. F. Clark, who is recognized as a pioneer manufacturer of electric storage water heaters, will be vice-president and sales manager of the Hoffman organization and G. H. Clark, who for many years has been associated with his father, will have charge of electrical engineering.

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Changes in Personnel Announced by Tenney

Effective December 1, Walter C. Parshall, office manager of the Fitchburg (Mass.) Gas & Electric Light Company, has been appointed commercial manager of the Rockland (N. Y.) Light & Power Company, with headquarters at Nyack; W. F. Sammett, formerly general superintendent of the Fitchburg company, has been appointed assistant to the manager, and Clifton R. Hayes, engineering manager Charles H. Tenney & Company, Boston, has been appointed general superintendent of the Fitchburg property. The engineering department of the Tenney organization will continue under the executive direction of F. C. Sargent, vice-president in charge of engineering, with headquarters in Boston.

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PAUL LEBENBAUM, formerly assistant electrical engineer for the Southern Pacific Company, San Francisco, has been named electrical engineer to succeed A. H. Babcock, who retired (ELECTRICAL WORLD, October 22, 1932, page 575). Following graduation from the College of Mechanics at the University of California in 1902, Mr. Lebenbaum joined the test department of the General Electric Company. Later he spent a year with the North Shore (California) Railroad, during its electrification, and since 1903 he has been identified with the Southern Pacific Company. He has been active in the affairs of the American Institute of Electrical Engineers on the Pacific Coast for a number of years.

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C. E. LAKIN, who has been connected with the National Electric Power Company, New York, in the capacity of electrical engineer, has removed to Greenville, Ohio, to become president of the Greenville Electric Light & Power Company. Mr. Lakin had extensive operating experience in the Middle West with the Albert Emanuel interests before joining the staff of the National Electric Power Company in 1926. He was identified with electrical properties at Sidney, Ohio; Emporia and Parsons, Kan.; Williamson, W. Va., and Kansas City, Mo., and in 1924 became assistant general manager of the Kansas Electric Power Company at Lawrence, Kan. Subsequently he was named chief electrical engineer of all the Emanuel properties.

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M. J. O'Connell Heads Ohio Companies

M. J. O'Connell, who was formerly executive vice-president of the Ohio Electric Power Company, the Columbus, Delaware & Marion Electric Company, the Reserve Power & Light Company and certain associated companies, was recently elected president of these companies, with headquarters in Marion. Before going to Ohio Mr. O'Connell was executive vice-president and general manager of the Eastern Shore Public Service Company at Salisbury, Md.

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OBITUARY

HERR ANTON LEDERER, a pioneer worker in metal-filament electric lamps and a leading Austrian authority on electrical illumination, died recently in Vienna at the age of 62.

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ROBERT E. ROBINSON, Florida representative of the General Electric Company, with headquarters in Miami, died suddenly November 14 from injuries sustained in an automobile accident. Mr. Robinson was a native of Augusta, Ga., and a graduate of the Georgia Institute of Technology. Following discharge from military service in the World War, he joined the teaching staff of Georgia Tech and after a year became identified with the Westinghouse Electric & Manufacturing Company. For the past five years Mr. Robinson had been connected with the General Electric Company. He was 36 years of age.

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EDWARD K. HALL, formerly vice-president of the American Telephone & Telegraph Company, a director of the Electric Bond & Share Company, of the New England Telephone & Telegraph Company and lecturer on industrial relations and management at the Amos Tuck School of Business Administration in Dartmouth College, died November 10 at his home in Hanover, N. H., at the age of 62. Mr. Hall was a native of Granville, Ill., and was educated at Dartmouth. For some years he was a member of the legal firm of Powers, Hall & Jones of Boston. He was noted for his philanthropies and distinction in public utility law.